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Aktenzeichen / Case Number / N^o du recours : T 600/88-3.3.1.

Anmeldenummer / Filing No / N^o de la demande : 82 870 049.2

Veröffentlichungs-Nr. / Publication No / N^o de la publication : 0 079 322

Bezeichnung der Erfindung: Manufacture of aqueous formaldehyde

Title of invention:

Titre de l'invention :

Klassifikation / Classification / Classement : C 07C 47/055

ENTSCHEIDUNG / DECISION

vom / of / du 25 January 1990

Anmelder / Applicant / Demandeur :

Patentinhaber / Proprietor of the patent /
Titulaire du brevet :

Monsanto Company

Einsprechender / Opponent / Opposant :

BASF AG

Stichwort / Headword / Référence : Formaldehyde/Monsanto

EPÜ / EPC / CBE Article 56

Schlagwort / Keyword / Mot clé : "Inventive step (denied) - distinction
without a difference - no different
technical effect"

Leitsatz / Headnote / Sommaire

Europäisches
Patentamt

European Patent
Office

Office européen
des brevets

Beschwerdekammern

Boards of Appeal

Chambres de recours



Case Number : T 600/88-3.3.1

D E C I S I O N
of the Technical Board of Appeal 3.3.1
of 25 January 1990

Appellant : BASF AG
(Opponent) D-8000 Ludwigshafen

Representative :

Respondent : Monsanto Company
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Decision under appeal : Decision of Opposition Division of the European
Patent Office of 13 July 1988 posted on
17 October 1988 rejecting the opposition filed
against European patent No. 0 079 322 pursuant
to Article 102(2) EPC.

Composition of the Board :

Chairman : K.J.A. Jahn
Members : R.W. Andrews
G.D. Paterson

Summary of Facts and Submissions

- I. The mention of the grant of European patent No. 0 079 322 in respect of European patent application No. 82 870 049.2, filed on 6 October 1982 and claiming priority of 8 October 1981 from a prior application filed in the United States of America, was announced on 22 May 1985 (cf. Bulletin 85/21). The only independent claim reads as follows:

"A process for the manufacture of an aqueous solution of formaldehyde comprising the steps of:

- a) oxidatively dehydrogenating methanol with air in the presence of a silver or copper catalyst and steam at elevated temperature; and
- b) absorbing the reaction product in an absorber comprising one or more absorption stages in series to form an aqueous formaldehyde solution containing free and combined methanol; characterised by
- c) stripping methanol from the aqueous formaldehyde solution with off-gas from the absorber in countercurrent flow in a stripping column comprising at least 1.5 theoretical transfer units for methanol stripping, the stripping being carried out at a temperature and at a ratio of stripping off-gas to aqueous formaldehyde to provide a concentration of condensible vapors of aqueous methanolic formaldehyde in the gas emerging from the stripping column of no more than about 50 mol percent".

- II. On 20 February 1986 a notice of opposition was filed requesting the revocation of the patent on the grounds of lack of novelty and inventive step. The opposition was supported, inter alia, by

(1) DE-B-2 444 586 (equivalent to US-A-4 119 673)

III. By a decision delivered orally on 13 July 1988, with written reasons posted on 17 October 1988, the Opposition Division rejected the opposition. The Opposition Division concluded that the subject-matter of the patent in suit was novel since the prior art did not disclose the use of the off-gas from an absorber in countercurrent flow as a stripping means. Furthermore, the proposed solution to the technical problem underlying the disputed patent of providing a process for stripping methanol from the product emerging from the absorber while minimising the amount of formaldehyde recycled to the reactor was inventive in the light of the disclosure in document (1).

The Opposition Division considered that the Opponent's allegation that the results obtained with the process of the disputed patent were the same as those achieved with the process of document (1) in respect to the yield of formaldehyde, conversion and the low methanol content of the product could not prejudice this finding since the prior art process obtained the desired result by recycling formaldehyde to the reactor, whereas the present process minimised formaldehyde recycling by using the absorber off-gas as a stripping means.

IV. A notice of appeal was lodged against this decision on 2 December 1988 with payment of the prescribed fee. A Statement of Grounds of Appeal was filed on 8 February 1989.

In their statement and during the oral proceedings held on 25 January 1990, the Appellants alleged that stripping of an aqueous formaldehyde solution using off-gas is described in Figures 1 and 3 of document (1). In any case

document (1) discloses that the material for recycling is advantageously stripped from the absorption solution with a gas. For economic reasons alone, the skilled person would obviously use as a stripping gas one that is already present in the process. In the present process there are only two alternatives, the air fed to the reactor or the off-gas from the absorber. It is within the competence of the skilled person to adapt the apparatus of Figure I of document (1) in accordance with the gas used for stripping.

Furthermore, in the Appellants' opinion the objective technical problem underlying the disputed patent was to provide a process for the preparation of a concentrated aqueous solution of formaldehyde containing a low amount of methanol since the alleged technical advantage of lower formaldehyde recycle was not supported by the Examples of the disputed patent. This objective technical problem is solved by document (1) by stripping the formaldehyde solution with a gas. Therefore, the only question to be answered was whether it was inventive to use off-gas for this purpose.

- V. In their observations in reply and during the oral proceedings, the Respondents emphasized the differences between the present process and the prior art one. In the Respondents' opinion document (1) does not teach the stripping of a formaldehyde solution with the off-gas from an absorber since the columns referred to by the Appellants are absorbers not strippers. Therefore, the off-gas of the prior art process, which corresponds to that of the claimed process, is led to an incinerator.

The teaching of document (1) and the disputed patent are different insofar as document (1) is directed to

extracting formaldehyde and water from the product for recycling to the reactor, whereas the disputed patent is concerned with the removal of methanol from the product for recycling to the reactor, while, at the same time, minimising the amount of formaldehyde recycled. This has the advantage of reducing the loss of reactor capacity. A further advantage resulting from the use of off-gas is that its volume can be adjusted in response to any variations in the process condition.

The Respondents conceded that the products of two processes are practically the same, but insisted that the means adopted to obtain them are different and that these means are not taught or suggested by the prior art.

VI. The Appellants requested that the decision under appeal be set aside and the patent revoked. The Respondents requested that the appeal be dismissed and that the patent be maintained on the basis of the claims as granted. Alternatively, as an auxiliary request, the Respondents requested that the patent be maintained on the basis of the claim filed on 13 July 1988. This claim reads as follows:

"A process for the manufacture of an aqueous solution of formaldehyde comprising the steps of:

- a) oxidatively dehydrogenating methanol with air in the presence of a silver or copper catalyst and steam at elevated temperature; and
- b) absorbing the reaction product in an absorber comprising one or more absorption stages in series to form an aqueous formaldehyde solution containing free and combined methanol; characterised by

c) stripping methanol from the aqueous formaldehyde solution with off-gas from the absorber in counter-current flow in a stripping column comprising at least 3 theoretical transfer units for methanol stripping, the weight ratio of off-gas from the absorber to aqueous formaldehyde from the first absorption stage entering the stripping column per unit time being in the range of 0.5:1 to 2.5:1, and the stripping being carried out at a temperature to provide a concentration of condensible vapours of aqueous methanolic formaldehyde in the gas emerging from the stripping column of no more than about 50 mol percent."

VII. At the conclusion of the oral proceedings the Board's decision to revoke the patent was announced.

Reasons for the Decision

1. The appeal complies with Articles 106 to 108 and Rule 64 EPC and is, therefore, admissible.
2. There are no formal objections to the claim in accordance with the auxiliary request under Article 123 EPC since it is supported by the original disclosure and does not extend the protection conferred. Thus, this claim represents a combination of Claims 1, 2 and 8 as filed and granted.
3. The disputed patent is concerned with a process for the manufacture of a concentrated aqueous solution of formaldehyde with a low methanol content comprising catalytically oxidatively dehydrogenating methanol with air in the presence of steam at elevated temperature, absorbing the reaction product in an absorber comprising one or more absorption stages and stripping methanol from

the resulting aqueous formaldehyde solution containing free and combined methanol. Document (1), which may be considered to represent the closest prior art, discloses a similar process.

- 3.1 In the light of this nearest prior art, the technical problem underlying the patent in suit may be seen in providing a mere alternative to this prior art process for the production of a concentrated aqueous solution of formaldehyde having a low methanol content.

According to the proposed solution this alternative comprises stripping the methanol from the aqueous solution of formaldehyde with the off-gas from the absorber in countercurrent flow in a stripping column having at least 1.5 theoretical transfer units for methanol stripping at a temperature and a ratio of stripping off-gas to aqueous formaldehyde so that the concentration of condensable vapours of aqueous methanolic formaldehyde in the gas emerging from the stripping column is no more than about 50 mol percent.

- 3.2 In the Board's view, the technical problem underlying the disputed patent cannot be considered to be the one formulated by the Opposition Division and the Respondents, viz to provide a process for the stripping of methanol from the aqueous solution for formaldehyde while, at the same time, minimising the amount of formaldehyde recycled to the reactor, since a comparison of Example 1 of the disputed patent with Example 3 of document (1) reveals that the ratios of the weight of formaldehyde recycled to the reactor to the weight of methanol fed to the reactor are 0.096 and 0.064 respectively. Thus, this comparison with the closest prior art clearly demonstrates

that this technical problem is not solved by the claimed process.

4. After examination of the cited prior art, the Board has reached the conclusion that the claimed subject-matter of the disputed patent is novel. Since novelty is no longer in dispute it is not necessary to consider this matter in detail.
5. It still remains to be examined whether the requirement of inventive step is met by the subject-matter in accordance with the main and auxiliary requests.
 - 5.1 Document (1) discloses a process for the manufacture of a concentrated aqueous solution of formaldehyde by catalytically oxidatively dehydrogenating methanol at elevated temperature with air in the presence of steam, followed by absorption in water of the formaldehyde formed, wherein the reaction is carried out with a specified throughput of methanol per square metre of catalyst bed cross-section and wherein 0.04 to 0.4 mole of formaldehyde and up to 1.8 mole of water per mole of total methanol fed to the catalyst are recycled (cf. Claim 1).

According to column 7, lines 9 to 20 of this document, the water, formaldehyde and, if necessary, methanol for recycling to the reactor may be taken from the reaction mixture between the catalyst bed and the absorption stage, but, preferably, they are supplied by either separating off a part of the aqueous solution of formaldehyde formed in the absorption stage or by extracting them from this solution with a gas. This latter method is suitably carried out by treating the air fed to the reaction with

the absorption solution or, preferably, with a part thereof.

As illustrated in Figure 1 of this document, air for the reaction enters a two-part wash column where, in the lower part, it is washed by a concentrated aqueous solution of formaldehyde obtained from the first absorption stage and, in the upper part, by the dilute aqueous solution of formaldehyde obtained from the upper part of the second absorption column (cf. column 8, lines 46 to 51, 55 to 58 and column 8, line 68 to column 9, line 3).

From a study of Example 1, the skilled person would realise that the reaction air not only entrains water and formaldehyde but also methanol. Thus, the solution fed to the lower part of the wash column has the following composition, expressed in percent by weight, formaldehyde 45.7%, methanol 2.1%, formic acid 0.01% and water 52.2% and the solution leaving the bottom of the column as the final product of the process contains formaldehyde 50.4%, methanol 1.7%, formic acid 0.008% and water 47.9%. Therefore, the skilled person would deduce from these figures that this part of the wash column acts as a stripper and it is possible to strip methanol from a concentrated aqueous solution of formaldehyde by means of air. Since, under the conditions prevailing in the wash column, air must be considered to be inert and since the skilled person is aware that, provided the gas is inert, its nature is of no importance to the stripping process, the skilled person would conclude that methanol can be stripped from a concentrated aqueous solution of formaldehyde by means of an inert gas.

5.2 In seeking an alternative to the process, disclosed in document (1) involving the use of a different inert gas, in the stripping process, the skilled person, solely on economic grounds, would immediately focus his attention on any other inert gases already present in the process and consider their suitability for use as stripping gases. Therefore, the skilled person would be led directly to the off-gas of the process, since this is the only other inert gas present in the process.

After recognising the potential of the off-gas as a stripping gas, the skilled person would be in the position to make the routine changes to the plant depicted in Figure 1 of document (1) necessary to adapt it for the use of off-gas in place of air as the stripping medium. In making these necessary changes, the skilled person would take into account the fact that, due to its composition, the off-gas could not be recycled to the reactor.

5.3 A skilled chemical engineer involved in the design of stripping columns is aware of the various factors which influence the efficiency of such columns and, in the course of his routine duties, would calculate the minimum number of theoretical transfer units or plates required for stripping methanol from a concentrated aqueous solution of formaldehyde in order to produce a formaldehyde solution with the desired low content of methanol. Therefore, the feature that the stripping column should comprise at least 1.5 theoretical transfer units cannot be considered to be inventive.

5.4 Furthermore, during the oral proceedings the Respondent agreed that it is part of the general knowledge of a skilled person that if a chemical reaction takes place

on absorption, for example, the methanol hemiformal reaction, the liquid phase residence time in the stripping column is an important design factor. Therefore, as a matter of course, the skilled chemical engineer would consider providing residence zones within the stripping column to allow the equilibrium reversal of the methanol hemiformal reaction to occur.

- 5.5 Moreover, it is within the competence of the skilled chemical engineer to determine the optimum conditions with regard to the temperature and ratio of stripping off-gas to aqueous formaldehyde in order to obtain the desired product in an efficient and economic manner.

- 6. In the Board's judgement, merely providing an alternative to the process for the manufacture of a concentrated aqueous solution of formaldehyde having a low methanol content disclosed in document (1) without any different technical effect requires no inventive step in the light of teaching of this document combined with the general knowledge of a skilled chemical engineer. Therefore, the subject-matter of Claim 1 in accordance with the main request does not involve an inventive step.
 - 6.1 Dependent Claims 2 to 17, which relate to preferred embodiments of the process in accordance with Claim 1, do not contain any independent inventive features and are, therefore, unallowable in the absence of an allowable main claim.

- 7. The main claim in accordance with the auxiliary request differs from that of the main request insofar as the stripping column must comprise at least 3 theoretical transfer units and the weight ratio of the off-gas from

the absorber to aqueous formaldehyde from the first absorption stage entering the stripping column is specified as being in the range of 0.5:1 to 2.5:1.

- 7.1 However, the design of stripping columns and the selection of the optimum operating conditions for a particular stripping procedure must be regarded as falling within the normal duties of the skilled chemical engineer. Therefore, this alternative to the known process is obvious in the light of the teaching of document (1) and the common general knowledge of the skilled chemical engineer. Thus, in the Board's judgement the subject-matter of the main claim in accordance with the auxiliary request does not involve an inventive step.
- 7.2 Any claims rendered appendent to this main claim would not contain any independent features and would, therefore, be unallowable in the absence of an acceptable main claim.
8. If, as the Respondents suggested that a disadvantage of the process disclosed in document (1) is that, under abnormal conditions, there is a risk of explosive mixtures being formed, this would, in fact, provide the skilled person with an incentive to contemplate replacing air by a gas that does not contain oxygen. Since the only gas within the process fulfilling this requirement is the off-gas, the skilled person would immediately consider the use of this gas as a stripping medium to overcome the alleged disadvantage of the prior art process.
9. The Respondents emphasized that the present process is distinguished from that of document (1) insofar as it is concerned with the stripping of methanol from a concentrated aqueous solution of formaldehyde whereas the known process is directed to the recycling of formaldehyde

and water. In the Board's view however, this is a distinction without a difference, since the object of both processes is identical, viz the manufacture of a concentrated aqueous solution of formaldehyde having a low methanol content, and the stripping of methanol from a concentrated formaldehyde solution is disclosed in document (1) and formaldehyde and water are recycled in the present process. The other differences between the two processes follow automatically from the use of off-gas in the present process.

Order

For the reasons, it is decided that:

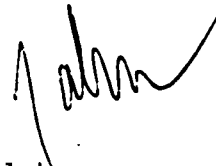
1. The decision of the Opposition Division is set aside.
2. The patent is revoked.

The Registrar



M. Beer

The Chairman



K. Jahn