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D E C I S I O N
of 25 August 1998

Case Number: T 0907/94 - 3.3.1

Application Number: 87117492.6

Publication Number: 0270007

IPC: C07C 17/34

Language of the proceedings: EN

Title of invention:
Process for producing vinylchloride monomer by pyrolysis of 1,2- dichloroethane

Patentee:
Tosoh Corporation

Opponent:
Hoechst AG

Headword:
Vinylchloride monomer/TOSOH CORP.

Relevant legal provisions:
EPC Art. 56, 114(2)

Keyword:
"Late filed evidence admitted (no) - not relevant"
"Inventive step (yes) - unexpected effect"

Decisions cited:
T 0002/83, T 0198/88, T 0536/88, T 1002/92

Catchword:
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Case Number: T 0907/94 - 3.3.1

D E C I S I O N
of the Technical Board of Appeal 3.3.1
of 25 August 1998

Appellant: (Opponent)
Hoechst AG
Werk Knapsack
50351 Hürth-Knapsack (DE)

Representative:
-

Respondent: (Proprietor of the patent)
Tosoh Corporation
4560, Oaza-Tonda
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Representative:
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Decision under appeal:
Decision of the Opposition Division of the European Patent Office posted 27 September 1994 rejecting the opposition filed against European patent No. 0 270 007 pursuant to Article 102(2) EPC.

Composition of the Board:

Chairman: P. Krasa
Members: R. Freimuth
W. Moser

Summary of Facts and Submissions

I. This appeal lies from the Opposition Division's decision rejecting the opposition against European patent No. 270 007, the single claim of which reads as follows:

"A process for producing vinylchloride monomer by pyrolysis of 1,2-dichloroethane comprising carrying out a heat exchange between a high temperature cracked gas flowing out of a pyrolysis furnace and the 1,2-dichloroethane to be introduced into the pyrolysis furnace with a flow rate of said cracked gas of from 5 m/s to less than 20 m/s to cool said cracked gas to 180 - 350°C and introducing gaseous 1,2-dichloroethane heated by the heat exchange into a preheating zone or a zone anterior thereto in the pyrolysis furnace."

II. Notice of Opposition had been filed by the Appellant (Opponent) requesting revocation of the patent as granted for lack of inventive step based on the sole document:

(2) DE-A-2 913 030.

III. The Opposition Division held that document (2) disclosing a process for the production of vinylchloride by pyrolysis of 1,2-dichloroethane preheated and vaporised before being supplied to the pyrolysis furnace by heat exchange with the high-temperature cracked gas having a flow rate of at least 20 m/s, did not render obvious the process of the patent in suit.

IV. The Appellant, submitting with the Statement of Grounds of Appeal the fresh documents

(1) EP-B-21 381
(3) DE-C-1 250 426 and
(4) DE-C-2 313 037,

argued that the subject-matter of the patent in suit did not involve an inventive step essentially for the following reasons:

A. Document (1) solved the same problem as the patent in suit in providing a process for pyrolysing 1,2-dichloroethane with low coke formation and a long reactor service life. According to the process of document (1), the 1,2-dichloroethane leaving the pyrolysis furnace at a temperature of 560 to 480°C was cooled to 220 to 120°C. The 1,2-dichloroethane was at least partially recycled into the pyrolysis furnace. Preferably, the cracked gas flowed through a single tube surrounded by the cooling medium (column 4, lines 25 to 32, in combination with column 6, lines 1 to 6). Based on the details specified in example 1, the flow rate of the cracked gas was calculated. For a given diameter of the tube of 45 mm, the cross section was 0.00636 m^2 and the resulting flow rate 23.2 m/s. The flow rate was similar to that of comparative example 3 of the patent in suit. However, in contrast to the latter, the service life of the heat exchanger in examples 2 to 5 in document (1) was 2 to 6 months without a significant loss of performance due to coking. Therefore, the feature of a flow rate of less than 20 m/s of the cracked gas in the sole claim of the patent in suit could not be an essential criterion. Moreover, the flow rate in example 4 of document (1) was calculated as being 14.5 m/s, i.e. below 20 m/s.

B. Document (2) disclosed in its example 1 a process wherein the cracked gas showed a flow rate of 30 m/s. A mere reduction of the feed stream of dichloroethane, e.g. down to 15 t/h, resulted in a calculated flow rate of 11.8 m/s. Therefore, the claimed flow rate of 5 to 20 m/s was already known from documents (1) and (2). Although document (2) did not contain information about the service life of the heat exchanger, it had to be assumed to be similar to that in document (1).

Therefore documents (1) and (2), either alone or in combination, hinted at the process of the patent in suit.

C. Document (3) disclosed a process for preparing vinylchloride corresponding to that of the patent in suit wherein the heated 1,2-dichloroethane was cooled and the unreacted 1,2-dichloroethane was recycled (claim 1). The reaction conditions applied in document (4) were similar. Additionally, it contained the information that the service life of the plant was 12 months (claim 1 and column 6, lines 27 to 31).

V. The Respondent (Proprietor of the patent) argued orally and in writing that, in accordance with Article 114(2) EPC, documents (1), (3) and (4) should not be admitted into the proceedings owing to their late filing and their lack of relevance, and that furthermore none of the cited documents, alone or in combination, rendered the subject-matter of the patent in suit obvious essentially for the following reasons:

A. The process disclosed in document (1) used a method of heat exchange different to that of the claimed process. In the claimed process, the heat exchange between the cracked gas and the 1,2-

dichloroethane to be introduced into the pyrolysis furnace was conducted without using a cooling medium, whereas in the process of document (1) a cooling medium was employed. Furthermore, in the examples of document (1) the heat was recovered as steam. The disadvantages of such a process were described in the specification of the patent in suit as being severe corrosion and even breakage of devices caused by leakage of hydrogen chloride.

The temperature level of the recovered heat was at 120 to 220°C in document (1), and thus lower than in the claimed process where that temperature level was at 180 to 350°C. The latter enabled a direct feed of 1,2-dichloroethane into the evaporator and the pyrolysis furnace and a more compact construction of the furnace.

On the other hand, document (1) did not describe the flow rate conditions and did not recognise the importance of the flow rate of the cracked gas. The Appellant's calculation of the flow rate in the examples of document (1), which was based on a pipe diameter of 45 mm, was meaningless. The pipe diameter was not disclosed in the description of document (1) and the Appellant's calculation of the cross- section of the pipe, and consequently the flow rate, was incorrect; the cross- section would be 0.00159 m^2.

Document (1) also addressed a different problem. The high costs associated with direct cooling using a large cooling amount was to be avoided, and the amount of cooling medium in the indirect heat exchanger ensured safe removal of heat during a power breakdown. Valuable heat was recovered, leading to an improvement in the efficiency of the process.

In view of the different object and solution of document (1), the subject-matter of the claimed process was not obvious.

B. The Opposition Division had already concluded that the skilled person had found no teaching or suggestion in the disclosure of document (2) indicating that by performing the process at the claimed flow rate of the cracked gas, the pressure drop and the amount of coke to be formed was reduced.

There was no disclosure whatsoever in document (2) pointing to a simple reduction in the amount of the introduced 1,2-dichloroethane, as was arbitrarily assumed by the Appellant, in order to arrive at a calculated flow rate of e.g. 11.8 m/s. On the contrary, claim 4 of document (2) disclosed a flow rate of at least 20 m/s, which clearly led away from the teaching of the claimed subject-matter.

C. Document (3) described a normal process for producing vinylchloride without specifying the conditions of the heat exchanger, such as the temperature and the gas flow rate, which were important features of the claimed process. Document (4) likewise described a normal process for producing vinylchloride, again without disclosing the heat recovery from the gas leaving the pyrolysis furnace. The 1,2-dichloroethane was evaporated by direct heating in a pyrolysis furnace or a heating furnace. Neither document (3) nor document (4) contained any hint or suggestion as to how to arrive at the claimed subject-matter.

VI. The Appellant requested that the decision under appeal be set aside and the patent be revoked.

The Respondent requested that the appeal be dismissed.

VII. Oral proceedings were held on 25 August 1998 in the absence of the Appellant who, after having been duly summoned, informed the Board that he would not attend. At the end of the oral proceedings the decision of the Board was given orally.

Reasons for the Decision

1. The appeal is admissible.

2. *Late-filed evidence (Article 114(2) EPC)*

2.1 Documents (1), (3) and (4) are new evidence cited in Appellant's Statement of Grounds of Appeal for the first time. No reasons have been given for this late filing. The Respondent, while providing comments on these documents, objected to their introduction into the appeal proceedings on the grounds of their late filing and their lack of relevance.

2.2 New evidence should only exceptionally be admitted into the proceedings before the Boards of Appeal if that evidence is *prima facie* highly relevant in the sense that it can reasonably be expected to change the eventual result of the proceedings (see decision T 1002/92, OJ EPO 1995, 605, point 3.4 of the reasons).

2.3 Documents (3) and (4) refer to processes for producing vinylchloride by pyrolysis of 1,2-dichloroethane. However, these processes belonging to the state of the art are fundamentally different from the process claimed in the patent in suit since they completely

lack the essential feature of the process of the patent in suit which is to recover heat by carrying out a heat exchange between the high-temperature cracked gas flowing out of a pyrolysis furnace and the 1,2-dichloroethane to be introduced into the pyrolysis furnace. For these reasons, none of these documents is more relevant than document (2) with respect to inventive step of the subject-matter of the patent in suit.

2.4 Document (1) refers to a process for producing vinylchloride by pyrolysis of 1,2-dichloroethane with recovery of heat by carrying out a heat exchange between the high-temperature cracked gas flowing out of a pyrolysis furnace and a heat-transfer medium to be used to heat other devices. However, this process belonging to the state of the art is substantially different from the claimed one since it lacks the essential feature of the process claimed in the patent in suit to carry out the heat exchange **immediately** between the cracked gas and the 1,2-dichloroethane **to be introduced** into the pyrolysis furnace without employing a heat-transfer medium. Furthermore, in contrast to the patent in suit, document (1) neither discloses the flow rate of the cracked gas nor teaches that the flow rate is essential in the process. The Appellant's calculations of flow rates are futile since any specification of the pipe diameter of the heat exchanger forming the basis of his calculations is missing in document (1). For these reasons, this document is not more relevant with respect to inventive step than document (2).

The Japanese family member of document (1), i.e. JP-A-56045424, has been acknowledged in the patent specification as conventional background art; however it is not considered therein essential or the closest prior art. Therefore, it does not automatically form

part of the appeal proceedings and is also regarded as a late-filed document (see decisions T 198/88, OJ EPO 1991, 254; T 536/88, OJ EPO 1992, 638).

2.5 Consequently, the Board, exercising its discretion under Article 114(2) EPC, decides to disregard documents (1), (3) and (4).

3. *Inventive step*

The only issue arising from this appeal is whether the subject-matter of the single claim as granted involves an inventive step.

3.1 The patent in suit refers to a process for producing vinylchloride by pyrolysis of 1,2-dichloroethane wherein a heat exchange is carried out between the high-temperature cracked gas flowing out of the pyrolysis furnace and the 1,2-dichloroethane to be introduced into the pyrolysis furnace. The heat exchange cools the cracked gas down to a range of from 180 to 350°C and heats up the 1,2-dichloroethane to be introduced into the pyrolysis furnace in the gaseous form.

A similar process already belongs to the state of the art: document (2) discloses in claim 1 a process for producing vinylchloride by pyrolysis of 1,2-dichloroethane. The high-temperature cracked gas flowing out of the pyrolysis furnace is cooled in the tube of a heat exchanger down to e.g. 310°C (page 7, line 36), vaporising at the same time the liquid 1,2-dichloroethane in the shell of the heat exchanger. This gaseous 1,2-dichloroethane is introduced into the pyrolysis furnace. The flow rate of the cracked gas is preferably at least 20 m/s (claim 4; page 7, lines 33 to 35), and a flow rate of 30 m/s is exemplified on page 7, line 34, and page 8, line 21.

The Board considers that this disclosure of document (2) represents the closest state of the art and, hence, takes it as the starting point when assessing inventive step.

3.2 As indicated in the patent in suit, the technical problem in view of this state of the art consists in the provision of a process for producing vinylchloride by pyrolysis of 1,2-dichloroethane wherein the pressure drop of the heat exchanger, in which the 1,2-dichloroethane to be introduced into the pyrolysis furnace is preheated and evaporated by the heat exchanged from the high-temperature cracked gas, is minimised, and wherein the amount of coke to be formed and attached to the heat exchanger, while the device is operated, is reduced (cf. specification of the patent in suit, column 3, lines 49 to 57; column 4, lines 25 to 34).

3.3 As a solution to this problem, the patent in suit suggests using a flow rate for the cracked gas of from 5 m/s to less than 20 m/s.

3.4 The Opposition Division, relying on test results disclosed in a test report submitted by the Respondent with his letter of 28 August 1991 during examination proceedings, held that the claimed process solved the above-defined technical problem. This test report relates to the process for producing vinylchloride by pyrolysis of 1,2-dichloroethane and comprises three examples A, B and C which were, apart from the applied flow rate of the cracked gas, all carried out in the same way. Example A with a flow rate of 14 m/s, corresponds to the claimed invention. Examples B and C with a flow rate of 24 m/s and 4 m/s respectively are comparative examples. Therefore, a comparison of the results indicated in these examples truly reflect the impact of the flow-rate feature, distinguishing the

solution suggested in the patent in suit from the process of document (2). This finding was not contested by the Appellant. This specific comparison of examples is, thus, a fair basis for the assessment of inventive step.

The process of example A according to the invention shows an increase in the pressure of from 3.65 MPa to 4.05 MPa after 90 days of operation. The pressure-loss increase rate is 4.4 KPa/day and the coking occurring in the heat exchanger has reduced its capacity by about 10%. The process of comparative example B shows an increase of the pressure from 3.85 MPa to 4.05 MPa after 30 days of operation. The pressure-loss increase rate is 6.7 KPa/day. Thus, the pressure-loss increase rate of comparative example B is 1.5 times inferior to that of example A according to the invention. The coking occurring in the heat exchanger of comparative example C reduced its capacity down to 17% within 25 days of operation compared with a reduction of 10% only within the longer period of 90 days in example A according to the invention. Thus, the latter result is considerably superior to the former one. The evidence on file convincingly demonstrates that the minimisation of the pressure drop and the reduction in coking has been achieved in the claimed process and that this is due to the flow rate of from 5 m/s to less than 20 m/s, i.e. the solution proposed by the patent in suit.

Therefore, the Board, concurring with the Opposition Division, is satisfied that the problem underlying the patent in suit is successfully solved by the claimed subject-matter. This finding was not contested by the Appellant either.

3.5 Finally, it remains to be decided whether or not the proposed solution to the problem underlying the patent in suit involves an inventive step.

Document (2) addresses neither the problem of minimising the pressure drop in the heat exchanger nor that of reducing the amount of coke formed and attached to the heat exchanger. The teaching on page 5, lines 19 to 21, that the carbon carried along with the cracked-gas stream is deposited only to a small extent in the heat exchanger so that its insulating effect is negligible, demonstrates that document (2) does not aim at reducing coking. Thus, document (2) does not give any incentive to minimise the pressure drop and to reduce coking in the heat exchanger by performing the process at the claimed flow rate of the cracked gas of from 5 m/s to less than 20 m/s.

The Appellant argued that a mere reduction of the feed stream of the 1,2-dichloroethane in example 1 of document (2) would have resulted in a flow rate of the cracked gas below 20 m/s, i.e. within the claimed range. However, this submission amounts to mere speculation since document (2) does not comprise any teaching in this respect. When assessing inventive step, the decisive question is not whether the skilled person **could** have done so, but whether he **would** have done so with the reasonable expectation of minimising the pressure drop and reducing coking (see for example decision T 2/83, OJ EPO 1984, 265, point 7 of the reasons). Moreover, document (2) even points away from the invention; it teaches that a flow rate of at least 20 m/s should preferably be used (claim 4; page 7, lines 33 to 35). Therefore, the Appellant's argument is not convincing as it is based on information available to the skilled person only from the disclosure of the patent in suit, i.e. on hindsight.

3.6 For these reasons, the Board concludes that document (2) does not render obvious the claimed solution to the problem underlying the patent in suit and that the subject-matter of the single claim as granted involves an inventive step within the meaning of Articles 52(1) and 56 EPC.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

E. Görgmaier P. Krasa