

Internal distribution code:

- (A) [] Publication in OJ
(B) [] To Chairmen and Members
(C) [X] To Chairmen
(D) [] No distribution

D E C I S I O N
of 17 July 2001

Case Number: T 0805/95 - 3.3.1

Application Number: 89306981.5

Publication Number: 0351167

IPC: C07C 57/04

Language of the proceedings: EN

Title of invention:

Method for production of methacrylic acid

Patentee:

SUMITOMO CHEMICAL COMPANY LIMITED, et al

Opponent:

BASF Aktiengesellschaft, Ludwigshafen

Headword:

Methacrylic acid/SUMITOMO et al

Relevant legal provisions:

EPC Art. 56

Keyword:

"Inventive step (no) - obvious alternative process"

Decisions cited:

T 0020/81, T 0355/97

Catchword:

-



Case Number: T 0805/95 - 3.3.1

D E C I S I O N
of the Technical Board of Appeal 3.3.1
of 17 July 2001

Appellant: SUMITOMO CHEMICAL COMPANY LIMITED
(Proprietor of the patent) 5-33, Kitahama 4-chome
Chuo-ku
Osaka-shi
Osaka 541-0041 (JP)

Representative: Rees, David Christopher
Kilburn & Strode
20 Red Lion Street
London WC1R 4PJ (GB)

Respondent: BASF Aktiengesellschaft, Ludwigshafen
(Opponent) -Patentabteilung - C6-
Carl-Bosch-Strasse 38
DE-67056 Ludwigshafen (DE)

Representative: -

Decision under appeal: Decision of the Opposition Division of the
European Patent Office posted 28 July 1995
revoking European patent No. 0 351 167 pursuant
to Article 102(1) EPC.

Composition of the Board:

Chairman: A. J. Nuss
Members: J. M. Jonk
S. C. Perryman

Summary of Facts and Submissions

I. The Appellant (Patentee) lodged an appeal against the decision of the Opposition Division by which the European patent No. 0 351 167 (European patent application No. 89 306 981.5) was revoked on the ground that the subject-matter of the claims of the patent in suit did not involve an inventive step.

II. The decision was based on the Claims 1 to 8 as granted, independent Claim 1 reading as follows:

"A method for the production of methacrylic acid, which comprises: subjecting isobutylene and/or tertiary butanol to catalytic vapor-phase oxidation with molecular oxygen in a first reactor packed with an oxide catalyst containing bismuth, molybdenum and iron, thereby mainly forming methacrolein; then supplying the gas consequently formed by reaction to a second reactor connected directly to the first reactor and packed with an oxide catalyst containing molybdenum and phosphorus, thereby subjecting the methacrolein to catalytic vapor-phase oxidation with molecular oxygen and consequently forming methacrylic acid characterised in that during the formation of the methacrylic acid, a rodlike or platelike insert made of metallic material or ceramic material is set in the empty space of the gas inlet part of the tube of the second reactor packed with the catalyst, the void ratio in portion of the empty space in the gas inlet part of the catalyst-packed tube of the second reactor being in the range of 30 to 99% by volume."

III. The opposition was based on the sole ground that the subject-matter as claimed in the patent in suit did not

involve an inventive step. It was supported by the following documents:

(1) JP-A-61 221149, and

(2) DE-A-2 550 838.

IV. Oral proceedings were held before the Board on 17 July 2001.

V. The Appellant (Patentee) defended the patentability of the patent in suit on the basis of the claims as granted. Moreover, he announced that he wished to defend the patentability of the patent in suit in amended form on the basis of two auxiliary requests should the Respondent raise novelty objections in the light of document (2).

He argued that the technical problem underlying the patent in suit in the light of the closest prior art as disclosed in document (1) was to provide an improved process for preparing methacrylic acid further reducing in the second reactor autoxidation and occlusion of the catalyst bed by polymeric and tarry by-products without the need of using a particularly formed catalyst.

Furthermore, he argued that the solution of this problem by using a specific insert while maintaining a particular void ratio in the empty space of the gas inlet part of the tube of the second reactor as indicated in Claim 1, and by applying in said second reactor an appropriate high gas stream velocity and at the same time an adequate high temperature of the gaseous reaction mixture preventing autoxidation (and thus the danger of explosion) and deposition of the by-

products on the catalyst, was not obvious in the light of document (2).

In this context, he argued that in assessing inventive step document (2) would not be relevant, since it concerned a different technical problem, namely the occlusion of the catalyst bed in the second reactor by molybdenum trioxide derived from the degradation of a molybdenum catalyst in the first reactor, whereas the technical problem underlying the patent in suit related to the occlusion of said catalyst bed by polymeric and tarry by-products present in the reaction gas derived from the first reactor. Moreover, he emphasised that the technical problem indicated in document (2) did not exist in the process of the present patent, since in this last process more sophisticated molybdenum containing catalysts were applied, such as those normally used in the first reactor at the time of the closest prior art. In support of this last contention he referred to a test-report submitted with his letter of 6 December 1995 showing that molybdenum trioxide formation was not a problem in the process of the patent in suit.

Moreover he argued, that even if said document (2) were considered in assessing inventive step, it would not render the process of the present patent obvious. According to the process of document (2) the reaction gas derived from the first reactor was cooled in order to deposit the molybdenum trioxide formed on a particular solid bodies, whereas according to the patent in suit, instead of such a cooling step, a heating step keeping a rodlike or platelike insert in the empty space part of the second reactor was applied and the forming of molybdenum trioxide even did not

occur at all due to the use of appropriate catalysts.

VI. The Respondent (Opponent) maintained his sole objection that the subject-matter of Claim 1 of the patent in suit did not involve the required inventive step. In this context, he argued that the process as claimed in the patent in suit included the use of catalysts in the first reactor giving rise to the forming of molybdenum trioxide and also the use of temperature and gas stream conditions in the second reactor which apparently would not solve the problems of autoxidation and occlusion. Moreover, by referring to the patent publication EP-A-630 879, he also argued that the technical problem indicated in document (2), namely that of the occlusion of the catalyst bed in the second reactor by molybdenum trioxide formed in the first reactor, even existed after the priority date of the present patent, so that the skilled person faced with occlusion problems in the catalyst bed of the second reactor would have no reason to disregard document (2).

VII. The Appellant requested that the decision under appeal be set aside, and that the patent be maintained as granted. (This request was his only one, since the Respondent did not raise any novelty objection).

The Respondent requested that the appeal be dismissed.

VIII. At the conclusion of the oral proceedings the Board's decision was pronounced.

Reasons for the Decision

1. The appeal is admissible.

2. The only point at issue in these appeal proceedings is the question whether the claimed subject-matter involves an inventive step.

3. For deciding whether or not a claimed invention meets this criterion, the Boards of Appeal consistently apply the problem and solution approach, which involves essentially
 - (a) identifying the closest prior art,
 - (b) assessing the technical results (or effects) achieved by the claimed invention when compared with the closest state of the art established,
 - (c) defining in the light thereof the technical problem which the invention addresses,
 - (d) verifying that the defined technical problem is solved by the embodiments encompassed within the claimed solution, and
 - (e) examining whether or not the claimed solution is obvious for the skilled person in view of the state of the art as a whole.

If the technical results of the invention provide some improvement over the closest prior art, the problem can be seen as providing such improvement, provided this improvement necessarily results from the claimed features for all that is claimed. If, however, there is no improvement, but the means of implementation are different, the technical problem can be defined as the provision of an alternative to the closest prior art.

4. The Board considers, in agreement with the parties, that the closest prior art with respect to the process of Claim 1 of the patent in suit is the disclosure of document (1).

This document (1) relates to a process for preparing methacrylic acid as indicated in the pre-characterising part of Claim 1 of the patent in suit, whereby the technical problem associated with this prior art process, namely, the occlusion of the catalyst in the second reactor by polymeric or tarry by-products of the reaction in the first reactor, is solved by the use of a cylindrical or ring-like catalyst having a large diameter in the second reactor (see the English translation of the relevant parts of document (1)). Consequently, document (1) makes available to the skilled person a process for preparing methacrylic acid which only differs from the process as claimed in the patent in suit in that according to the claimed process the empty space in the gas inlet part of the second reactor contains a rodlike or platelike insert made of metallic material or ceramic material, whereby the void ratio in said empty space is in the range of 30 to 99% by volume.

5. Regarding this prior art, the Appellant submitted that the technical problem to be solved was to improve the process by further reducing in the second reactor the autoxidation of the methacrolein containing gas and occlusion of the catalyst.

However, as indicated above, only such improvements can be recognised for defining the technical problem underlying the patent in suit which are actually achieved by substantially all the embodiments

encompassed within the scope of the claim.

It is true, that by applying certain process features falling under the scope of present Claim 1, such as (i) the use of a particular catalyst in the first reactor, (ii) cooling the reaction gas derived from the first reactor enough for the prevention of autoxidation and the avoidance of the danger of explosion, and (iii) subsequently elevating the temperature of the gaseous reaction mixture and at the same time adjusting an appropriate linear speed thereof enabling the by-products to pass the latter step catalyst bed in a harmless state while minimising the risk of autoxidation (see in this context page 4, lines 10 to 25, of the patent in suit, as well as the examples therein), the technical problem as defined by the Appellant might be solved. However, having regard to the importance of such process features as contended by the Appellant and the broad scope of present Claim 1, in particular concerning the catalyst in the first reactor (which is not limited to the catalysts of document (1)) and with respect to the lack of any limitation of the temperature and gas flow conditions in the second reactor, the Board does not consider it credible that the improvements as indicated by the Appellant could be achieved by substantially all the embodiments encompassed within the scope of the claim. Moreover, the Appellant did not submit any evidence in support of his submissions.

Thus, in view of these considerations the technical problem as defined by the Appellant cannot be accepted by the Board and consequently a reformulation of this technical problem becomes necessary to meet a less ambitious objective (see in this context e.g. T 20/81,

OJ EPO 1982, 217, point 3 of the reasons; and T 355/97 dated 5 July 2000 (not published in the OJ EPO), point 2.6 of the reasons).

6. In the Board's judgment, and having regard to the broad scope of Claim 1 of the present patent, the technical problem underlying the patent in suit in the light of the closest state of the art can only be seen in the provision of an alternative process for preparing methacrylic acid.
7. The patent in suit suggests as the solution to this problem, a process according to Claim 1 which is characterised in that the empty space in the gas inlet part of the second reactor contains a rodlike or platelike insert made of metallic material or ceramic material, the void ratio in said empty space being in the range of 30 to 99% by volume.

In view of the technical information in the patent in suit, in particular in the examples, the Board is satisfied that the problem as defined above has been solved. This was never challenged by the Respondent.

8. The remaining question is thus whether the prior art as a whole would have suggested to a person skilled in the art solving the technical problem indicated above in the proposed way.
9. As indicated above (see point 4), document (1) does not mention the use of any insert in the empty space of the inlet part of the second reactor at all, so that it cannot render the claimed solution of the above defined technical problem obvious by itself.

10. Document (2) discloses that a basic drawback of all catalysts comprising a molybdenum oxide or any molybdenum compound which, under the conditions of the use of the catalyst, is a source of molybdenum trioxide, has been found to be that when such catalysts are employed at an elevated temperature in a reaction zone through which there is passed a gas which is subsequently to be introduced into a subsequent reaction zone, there is an appreciable contamination of the effluent gas by vapours of molybdenum trioxide leading to occlusion problems in said subsequent reaction zone if the temperature in this last zone is lower than in the first one (see page 3, last paragraph to page 5, first paragraph).

It discloses such a situation in particular in relation to a process for oxidising propylene or isobutylene in preparing acrylic or methacrylic acid as the end product, wherein (i) in an initial oxidation step the molybdenum containing catalyst, such as an oxide catalyst containing molybdenum, bismuth and iron, is normally employed at about 300°C to 500°C, (ii) the effluent gas comprising acrolein or methacrolein is cooled by approximately 40°C to 150°C to the range of temperatures most commonly employed in a secondary oxidation step, and (iii) the secondary oxidation step is carried out at temperatures within the range of approximately 240°C to 300°C in the presence of a second catalyst acting at these lower temperatures in the same way as the catalyst of the primary reaction zone (see page 4, lines 15 to 28, page 10, first and second paragraph, the example, and claim 7; and concerning the nature of the molybdenum-containing catalyst page 1, first paragraph, page 2, second paragraph to page 3, line 3, and page 20, last

paragraph to page 21, line 2).

Furthermore, this document describes that the occlusion problems in the secondary oxidation step can be solved by cooling of the hot molybdenum trioxide containing effluent gas derived from the primary oxidation step in the presence of solid bodies upon which the molybdenum trioxide is allowed to be deposited, whereby said solid bodies may be in the form of metal vanes or simple rods, or in the form of ceramic balls arranged into a roughly spiral configuration, and whereby the effective void space in the deposition zone containing said solid bodies is greater than 40%, preferably more than 50% and in particular approximately 60% (see page 7, last paragraph to page 8, first paragraph; page 12, last paragraph; page 16, last paragraph; page 17, lines 1 to 7; page 18, last paragraph to page 19, first paragraph; and claims 1 to 5).

Therefore, in the Board's judgment, a skilled person faced with the technical problem as defined above would find in document (2) a clear incentive that this problem could be solved by a process falling under Claim 1 of the patent in suit and that at the same time the occlusion problems deriving from the forming of molybdenum trioxide as indicated in document (2) could be avoided.

11. It is true, that document (2) does not explicitly disclose the positioning of the insert solely in the empty space of the second reactor as claimed in Claim 1 of the patent in suit. However, in the Board's judgment, a person skilled in the art would immediately understand in reading document (2) that the position of the zone containing the solid bodies used for purifying

the effluent gas derived from the first oxidation reactor in order to avoid occlusion problems in the catalyst bed of the second reactor is not critical as long as the molybdenum trioxide is effectively deposited on the surface of the insert(s) and undeposited molybdenum trioxide can pass through the second reactor without further depositing if the temperature of the reaction gas is not further reduced (see page 10, second paragraph, lines 5 to 14). Nothing was submitted by the Appellant which would point to the contrary.

12. The Appellant argued that the technical problem indicated in document (2) did not exist in the process of the present patent, since in this last process more sophisticated molybdenum containing catalysts were applied, such as those normally used in the first reactor of the closest prior art, and that therefore in assessing inventive step this document would not be relevant.

However, this argument fails, since the definition of the catalyst in the first reactor in Claim 1 of the patent in suit not only comprises the use of catalysts applied in accordance with the closest prior art document (1) but also those used in accordance with document (2) (see also point 10, first paragraph).

13. Furthermore, the Appellant submitted that document (2) would not render the process of the present patent obvious, since it related to a process wherein the reaction gas derived from the first reactor was cooled in order to deposit the molybdenum trioxide formed on particular solid bodies, whereas according to the patent in suit said reaction gas was heated in the

empty space part of the second reactor keeping a rodlike or platelike insert therein in order to prevent occlusion by polymeric and tarry by-products derived from the first reaction step.

However, this argument cannot be accepted by the Board either, since the broad scope of Claim 1 of the patent in suit not only comprises the use of catalysts applied in accordance with document (2) involving the occlusion problems related to such catalysts, but also does not exclude the cooling step as disclosed in document (2). Moreover, the Board observes that document (2) not only teaches that by cooling the reaction gas the molybdenum trioxide can be removed from the reaction gas derived from the first reactor by deposition on the solid bodies, but that also high boiling organic impurities could be removed from the reaction gas prior to its introduction into the catalyst bed of the second reactor if the purity of the cooled reaction gas would be an essential feature (see page 10, last paragraph to page 11, first paragraph).

14. Thus, in the Board's judgment, document (2) gives a clear pointer to the skilled person to solve the technical problem as defined above by a process falling under the broad scope of Claim 1 of the patent in suit.
15. It follows that the subject-matter of Claim 1 lacks inventive step and, thus, does not comply with Article 56 EPC.

The further claims fall with Claim 1, since the Board can only decide on the Appellant's request as a whole.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:

The Chairman:

N. Maslin

A. Nuss