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D E C I S I O N
of 20 December 2005

Case Number: T 0612/03 - 3.3.01

Application Number: 95934533.1

Publication Number: 0734372

IPC: C07C 51/265

Language of the proceedings: EN

Title of invention:
Process for preparing aromatic carboxylic acids with efficient energy recovery

Patentee:
BP Corporation North America Inc.

Opponent:
EASTMAN CHEMICAL COMPANY

Headword:
Energy recovery/BP

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

Keyword:
"Late-filed documents - not admitted"
"Novelty (yes) - no novelty destroying prior art disclosure"
"Inventive step (yes) - non obvious solution"

Decisions cited:
-

Catchword:
-

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Case Number: T 0612/03 - 3.3.01

D E C I S I O N
of the Technical Board of Appeal 3.3.01
of 20 December 2005

Appellant: (Opponent)	EASTMAN CHEMICAL COMPANY 100 North Eastman Road Kingsport TN 37660 (US)
Representative:	Wibbelmann, Jobst Wuesthoff & Wuesthoff Patent- und Rechtsanwälte Schweigerstrasse 2 D-81541 München (DE)
Respondent: (Proprietor of the patent)	BP Corporation North America Inc. 200 East Randolph Drive MC 2207A Chicago IL 60601 (US)
Representative:	Hamer, Christopher K. Mathys & Squire 120 Holborn London EC1N 2SQ (GB)
Decision under appeal:	**Interlocutory decision of the Opposition Division of the European Patent Office posted 25 March 2003 concerning maintenance of European patent No. 0734372 in amended form.**

Composition of the Board:

Chairman: A. Nuss
Members: P. P. Bracke
J. Van Moer

Summary of Facts and Submissions

I. The Opponent was the sole Appellant against the Opposition Division's decision to maintain European patent No. 0 734 372 on the basis of the auxiliary request submitted on 22 January 2003 at the oral proceedings before the Opposition Division, which consisted of twelve claims, with the independent claims reading:

"1. A continuous process for preparing aromatic carboxylic acids by the exothermic liquid-phase oxidation reaction of an aromatic feedstock compound wherein energy is efficiently recovered from the exothermic liquid-phase oxidation reaction, which process comprises:

(a) oxidizing an aromatic feedstock compound to an aromatic carboxylic acid in a liquid-phase reaction mixture comprising water, a low molecular weight monocarboxylic acid solvent, a heavy metal oxidation catalyst and a source of molecular oxygen, at a pressure from 0 kg/cm^2 to 35 kg/cm^2 and at a temperature from 150°C to 240°C to produce a gaseous high pressure overhead stream comprising water, gaseous by products, and gaseous low-molecular weight monocarboxylic acid solvent;

(b) directing the gaseous high pressure overhead stream to a high efficiency separation apparatus to separate water from low molecular weight carboxylic acid such that at least 95 weight percent of the low-molecular weight monocarboxylic acid is removed from the gaseous high pressure

overhead stream from the liquid-phase oxidation reaction to form a second high pressure overhead stream comprising water and gaseous byproducts formed during the oxidation reaction; and

(c) passing second high pressure overhead stream from step (b) directly or indirectly to an expander for recovering energy from the second high pressure overhead stream."

"10. A reactor apparatus suitable for use in the process of Claim 1 for converting an alkyl aromatic feedstock compound to an aromatic carboxylic acid by the liquid phase oxidation of the aromatic feedstock compound in a reaction mixture comprising acetic acid reaction solvent and water, and which provides for the efficient recovery of energy produced by the oxidation reaction, comprising

a reaction vessel suitable for conducting the liquid phase oxidation of an aromatic feedstock compound at an elevated temperature,

a high efficiency distillation column capable of separating a mixture of acetic acid and water such that vapour exiting the distillation column is less than about 0.5 weight percent acetic acid,

a means for directing vapor produced by the liquid-phase oxidation reaction in the oxidation reactor to the distillation column, and

an expander to recover energy from the vapour exiting the distillation column."

II. The Opposition Division was of the opinion that the claimed process and apparatus according to the auxiliary request (see point I above) differed from the prior art processes and apparatus by the use of a high efficiency separation apparatus enabling the separation of water from the low molecular weight monocarboxylic acid solvent. Since the problem underlying the invention consisted in recovering energy in an efficient way, the proposed solution was based on the finding that the water component from the oxidation reactor exhaust gas was also a significant source of energy and this was not suggested in the prior art, the claimed process and apparatus were not obviously derivable therefrom.

III. Oral proceedings, at which the Appellant and the Respondent (Proprietor of the patent) were present, took place on 20 December 2005.

IV. The Appellant essentially submitted that the claimed subject-matter was not novel over the disclosure of document

(4) JP-A-55-99517 (English translation)

and that it was obviously derivable from the teaching of document (4) in combination with document

(3) GB-A-1 373 230,

or from the teaching of document (3) in combination with document

(2) Journal A, 1984, vol. 25(3), pages 165 to 167.

Moreover, the Appellant cited documents

(5) Recent Technology Developments on TA Manufacturing (13), Nippon Chemtec Consulting Inc. (SR-121-13), monthly report No. 74, February 1992;

(6) Recent Technology Developments on TA Manufacturing (12), Nippon Chemtec Consulting Inc. (SR-121-12), monthly report No. 73, January 1992;

(7) US-A-4 471 619; and

(8) Process Improvements by Japanese TA Manufacturers, Nippon Chemtec Consulting Inc., special report No 14, August 1994

during the written appeal procedure.

V. With telefax dated 1 December 2005 the Respondent filed sets of claims according to first to fourth auxiliary requests.

Moreover, the Respondent submitted that documents (5) to (8) were late filed and should not be admitted in the proceedings. Furthermore, he essentially repeated the arguments of the Opposition Division as set out in point II above.

VI. The Appellant requested that the decision under appeal be set aside and that the European patent No. 0 734 372 be revoked.

The Respondent requested that the appeal be dismissed or that the patent be maintained on the basis of one of the four auxiliary requests filed with telefax dated 1 December 2005.

Reasons for the Decision

1. The appeal is admissible.

2. *Admissibility of documents (5) to (8)*

2.1 Documents (5) and (6) are monthly reports and document (8) is a special report, all bearing printed on the cover sheet "Nippon Chemtec Consulting Inc." and a date prior to the priority date of the patent in suit. The Respondent contested in the written procedure on the basis of lack of evidence that those documents were effectively publicly available at the dates appearing on the cover sheets. Nevertheless, the Appellant did not provide any evidence to prove the availability of documents (5), (6) and (8) in an unrestricted way to the public before the priority date of the patent in suit.

According to the established jurisprudence of the Boards of Appeal, if a board is unable to verify facts alleged, it goes to the detriment of the party relying on those facts and needing to prove them. Since, in the present case, the Appellant did not provide any proof of the availability of documents (5), (6) and (8) to the public, those documents are not considered to belong to the state of the art.

2.2 Document (7) discloses a method of utilising energy present in the overhead vapour stream of a fractionation column to perform useful work by depressurising the overhead vapour stream through a turbine. Since, however, document (7) is completely silent about the energy recovery from a water component, let alone of a water component of a reactor exhaust gas, which is an essential feature in the claimed process and apparatus, it is not relevant for the examination of novelty and inventive step of the claimed process and apparatus.

2.3 Thus, the late filed documents (5) to (8) are not admitted into the proceedings (Article 114(2) EPC).

3. *Main request*

3.1 Article 123(2) and (3) EPC

The Board does not have any reason to contest the finding of the Opposition Division that the amendments in Claims 1 and 10 do not contravene Article 123(2) and (3) EPC. Since this was not contested by the Appellant, there is no need to give any detailed reasoning thereto.

3.2 Novelty of Claim 1

3.2.1 Document (4) describes a method of recovering energy from exhaust gas originating from terephthalic acid production plants using the liquid phase oxidation method by adding a flame assistant to that exhaust gas and catalytically oxidising the flammable components before recovering heat and pressure in, for example, a gas turbine.

Since in the third full paragraph on page 3 of document (4) it is stated that the exhaust gas is released from the reaction tank via a gas-liquid separator and may contain 3800 ppm acetic acid and 3200 ppm water, the Appellant was of the opinion that document (4) discloses a method of recovering energy from an exhaust gas originating from terephthalic acid production plants wherein water was separated from acetic acid. Therefore, document (4) was novelty destroying for the claimed process.

3.2.2 However, according to the jurisprudence of the Boards of Appeal, in order to be novelty-destroying, all features in the claimed combination must be directly and unambiguously derivable from the teaching of one single document.

Since document (4) only describes the use of a gas-liquid separator and not an high efficiency separation apparatus **to separate water from low molecular weight carboxylic acid such that at least 95 weight percent of the low molecular weight carboxylic acid is removed**, for this reason alone, document (4) does not destroy the novelty of Claim 1.

In particular, the contents of acetic acid and water in the exhaust gas cited in the third full paragraph on page 3 may not give any indication about the amount of acetic acid removed by the gas-liquid separator. Since document (4) is completely silent about the content of acetic acid in the exhaust gas entering the gas-liquid separator, it may also not provide any information about the weight percent of acetic acid removed.

3.3 Novelty of Claim 10

Moreover, in the absence of any teaching of a high efficiency distillation column capable of separating a mixture of acetic acid and water such that vapour exiting the distillation column is less than about 0.5 weight percent acetic acid, document (4) cannot be considered to destroy the novelty of Claim 10.

3.4 Inventive step of Claim 1

3.4.1 In accordance with the "problem-solution approach" applied by the Boards of Appeal to assess inventive step on an objective basis, it is in particular necessary to establish the closest state of the art forming the starting point, to determine in the light thereof the technical problem which the invention addresses and successfully solves, and to examine the obviousness of the claimed solution to this problem in view of the state of the art.

3.4.2 The "closest state of the art" is normally a prior art document disclosing subject-matter aimed at the same objective as the claimed invention and having the most relevant technical features in common.

Since the claimed subject-matter concerns a process for preparing aromatic carboxylic acids by the exothermic liquid-phase oxidation reaction of an aromatic feedstock compound wherein **energy is efficiently recovered** from the exothermic liquid-phase oxidation reaction and document (3) is completely silent about

the recovery of energy, document (3) cannot represent the closest state of the art.

Contrary thereto, document (2) as well as document (4) are each concerned with the recovery of energy from the exhaust gas of a terephthalic acid production unit. Indeed, document (2), cited in paragraph [0003] of the patent in suit, describes on page 167 under the heading "6. Off-gas expander" such recovery and document (4) describes in the third paragraph on page 4 a method wherein the exhaust gas of a terephthalic acid production plant is subjected to recovery of the heat and pressure of the treated gas in a motive power recovery apparatus.

Thus, document (2) as well as document (4) can each independently be considered as the closest state of the art and, thus, as a suitable starting point for assessing inventive step.

3.4.3 From paragraph [0003] of the patent in suit it further follows that prior art processes as the one described in document (2) did not fully utilise the energy available in the high-pressure exhaust gas.

3.4.4 Therefore, in agreement with the teaching of paragraph [0004] of the patent in suit, starting from a process as described in either document (2) or (4), the problem to be solved may be considered to provide a process for manufacturing aromatic carboxylic acids wherein the energy generated by the highly exothermic, high pressure oxidation reaction can be economically and efficiently recovered and, in fact, serve as a net generator of energy.

3.4.5 The patent in suit claims to solve this problem by the process defined in Claim 1.

3.4.6 The Board does not have any reason to doubt that the above-mentioned problem was effectively solved by the process of Claim 1, which has not been contested by the Appellant.

3.4.7 Therefore, it remains to be decided whether in the light of the teachings of the cited documents a skilled person seeking to solve the problem as defined in point 3.4.4 above would have arrived at the process of Claim 1 in an obvious way or not.

The only disclosure in document (2) relevant for the claimed process is the one in the paragraph under the heading "6. Off-gas expander", describing the use of a turbo expander as drive for air compressors. It is stated therein only that the exhaust gas from the terephthalic acid production unit mainly consists of nitrogen, without giving any information about the presence of acetic acid or water therein.

Moreover, although document (4) describes in the fourth paragraph on page 3 the presence of water in the exhaust gas exiting the gas-liquid separator, the passage concerned with the recovery of energy, namely the third paragraph on page 4, only states "the treated, high-temperature, high-pressure gas is directly subjected to effective recovery of the heat and pressure of the treated gas in a motive power recovery apparatus" without giving any indication of the

presence of water originating from the liquid-phase reaction mixture.

Therefore, neither from document (2) nor from document (4) can any information be obtained about the use of the energy contained in the water component originating from the liquid-phase reaction mixture.

3.4.8 Document (3) describes the production of terephthalic acid which is of sufficiently high quality to be used in the production of fibre grade polyesters by the direct polymerisation method. As it was found that the **discoloration** of the terephthalic acid could be **avoided** by reducing the amount of water in the reaction medium, it proposes the use of a fractional distillation column in which the acetic acid vapour is condensed while the water vapour is not condensed (see page 1, lines 10 to 14 and 51 to 56, and page 2, lines 50 to 58).

3.4.9 Since document (3) discloses the interchangeability of gas-liquid separators by fractional distillation columns, the Appellant submitted that the claimed process was obvious from the combined disclosure of any of document (2) and (4) with document (3).

However, since document (3) is completely silent about the recovery of energy, no suggestion can be found therein that the replacement of a gas-liquid separator by a fractional distillation column could solve the problem as defined in point 3.4.4.

Thus, the claimed process is not obviously derivable from the disclosure of any of documents (2) and (4) combined with the disclosure of document (3).

3.4.10 The Appellant also submitted that, according to the wording of Claim 1, the water present in the second high pressure overhead stream may be a miniscule amount and only a part of that stream may be passed to the expander. Therefore, such features should be neglected in assessing inventive step.

However, in the claimed process the recovery of any amount of energy contributes to the problem of energy consumption and, thus, the presence of even minimal amounts of water in the second high pressure overhead stream and the passing of only part of that stream to the expander contributes to the recovery of energy. Thus, the feature in step (b) of the claimed process "to form a second high pressure overhead stream comprising water and gaseous by-products" and the feature in step (c) of the claimed process "passing second high pressure overhead stream from step (b) directly or indirectly to an expander" are essential features of the claimed process.

3.5 Inventive step of Claim 10

The claimed apparatus is also not derivable from the cited prior art for the reasons given in point 3.4 above for the claimed process.

4. *Auxiliary requests*

In the light of the above findings, there is no need to consider the first to fourth auxiliary requests provided with telefax of 1 December 2005.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar: The Chairman:

N. Maslin A. Nuss