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**Datasheet for the decision  
of 14 February 2019**

**Case Number:** T 0956/15 - 3.3.10

**Application Number:** 09711918.4

**Publication Number:** 2244995

**IPC:** C07C51/12

**Language of the proceedings:** EN

**Title of invention:**

PROCESS FOR THE PRODUCTION OF ACETIC ACID

**Patent Proprietor:**

BP Chemicals Limited

**Opponent:**

Celanese International Corporation

**Headword:**

PROCESS FOR THE PRODUCTION OF ACETIC ACID / BP Chemicals

**Relevant legal provisions:**

EPC Art. 56

**Keyword:**

Inventive step - (no)

**Decisions cited:**

**Catchword:**



**Beschwerdekammern**

**Boards of Appeal**

**Chambres de recours**

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Case Number: T 0956/15 - 3.3.10

**D E C I S I O N**  
**of Technical Board of Appeal 3.3.10**  
**of 14 February 2019**

**Appellant:** BP Chemicals Limited  
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**Representative:** Hill, Simon Stephen  
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**Respondent:** Celanese International Corporation  
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**Decision under appeal:** **Decision of the Opposition Division of the  
European Patent Office posted on 13 March 2015  
revoking European patent No. 2244995 pursuant to  
Articles 101(2) and 101(3) (b) EPC.**

**Composition of the Board:**

**Chairman** P. Gryczka  
**Members:** F. Blumer  
J.-C. Schmid

## Summary of Facts and Submissions

I. The Appellant (Proprietor of the patent) lodged an appeal against the decision of the Opposition Division revoking European patent No. 2 244 995, independent claim 1 thereof reading as follows:

"1. A process for the production of acetic acid which process comprises the steps of:

- (a) introducing methanol and/or a reactive derivative thereof selected from methyl acetate, dimethyl ether, and methyl iodide and carbon monoxide into a first reaction zone containing a liquid reaction composition comprising a carbonylation catalyst, optionally a carbonylation catalyst promoter, methyl iodide, methyl acetate, acetic acid and water;
- (b) withdrawing at least a portion of the liquid reaction composition together with dissolved and/or entrained carbon monoxide and other gases from the first reaction zone;
- (c) passing at least a portion of the withdrawn liquid reaction composition to a second reaction zone, wherein at least a portion of the dissolved and/or entrained carbon monoxide is consumed;
- (d) passing at least a portion of the liquid reaction composition from the second reaction zone into a flash separation zone to form: a vapour fraction, which comprises acetic acid, methyl iodide, methyl acetate and low pressure off-gas, comprising carbon monoxide; and a liquid fraction, which comprises carbonylation catalyst and optional carbonylation catalyst promoter;
- (e) passing the vapour fraction from the flash separation zone to one or more distillation zones to recover acetic acid product;

wherein the temperature of the liquid reaction composition withdrawn from the first reaction zone is in the range of 170 to 195°C; and the temperature of the liquid reaction composition passed from the second reaction zone to the flash separation zone is at least 8°C greater than the temperature of the liquid reaction composition withdrawn from the first reaction zone."

II. The Respondent (Opponent) requested in its notice of opposition the revocation of the patent-in-suit in its entirety on the grounds of lack of novelty and inventive step (Article 100(a) EPC), and insufficient disclosure of the invention (Article 100(b) EPC). Inter alia the following documents were cited in the opposition proceedings:

- (1) WO-A-03/097567 and
- (2) EP-A-0 846 674.

According to the Opposition Division, the patent-in-suit provided enough information to allow the skilled person to reproduce the invention without any inventive effort or undue burden. The requirements of Article 83 EPC were therefore fulfilled. The processes for producing acetic acid disclosed in documents (1) or (2) comprising the steps (a) to (e) as required by claim 1 of the patent as granted did not include the combination of a temperature of the liquid reaction composition withdrawn from the first reaction zone varying from 170°C to 195°C **and** a temperature of the liquid reaction composition passed from the second reaction zone to the flash separation zone being at least 8°C greater than the temperature of the liquid reaction composition withdrawn from the first reaction zone. The subject-matter of the claims of the patent as

granted was therefore novel. With respect to inventive step, document (2) represented the closest prior art to the invention. It had not been demonstrated that increasing the temperature in the second reaction zone caused an increase in acetic acid yield, since the process of comparative example A of the patent-in-suit did not represent a process according to document (2) due to the lack of a second reactor. Accordingly, the patent-in-suit failed to show that the technical problem of producing acetic acid at a higher efficiency had been successfully solved by the claimed process. The subject-matter of claim 1 therefore lacked an inventive step. Claim 1 of the first auxiliary request required that the flash separation zone comprised an adiabatic flash vessel. Document (1) disclosed a flash separation zone comprising an adiabatic flash vessel. Therefore the subject-matter of claim 1 of the first auxiliary request also lacked an inventive step. Claim 1 of the second auxiliary request required that fresh carbon monoxide was introduced into the second reaction zone. The feature was already disclosed in the process of document (2). Accordingly, the subject-matter of the second auxiliary request also lacked in inventive step.

III. During the oral proceedings before the Board held on 14 February 2019, the Appellant defended the maintenance of the patent as granted and on basis of a first and a second auxiliary request. These requests correspond to those pending in the decision under appeal.

Claim 1 of the first auxiliary request differs from claim 1 of the main request in that the flash separation zone comprises an adiabatic flash vessel.

Claim 1 of the second auxiliary request differs from claim 1 of the main request in that carbon monoxide, in

addition to that dissolved and/or entrained in the liquid reaction composition withdrawn from the first reaction zone, is introduced into the second reaction zone.

- IV. According to the Appellant, with respect to inventive step, document (2) represented the closest prior art to the invention. The process of claim 1 of the patent as granted differed from the process for producing acetic acid disclosed in document (2) in the combination of two features, namely the temperature of the liquid reaction composition withdrawn from the first reaction zone which is in the range of 170 to 195 °C and the temperature of the liquid reaction composition passed from the second reaction zone to the flash separation zone which is at least 8 °C greater than the temperature of the liquid reaction composition withdrawn from the first reaction zone. The combination of these two features provided improvements in the process for the production of acetic acid by carbonylation. The increase in temperature of the liquid reaction composition being passed to the flash separation zone resulted in an improved separation of acetic acid and allowed that the first reaction zone be operated at a lower temperature. Such lower temperature was advantageous in that it resulted either in an increased rate of carbonylation or less venting of high pressure off gas, containing valuable carbon monoxide, from the first reaction zone.

The enrichment in acetic acid of the vapour phase in the flash separation zone was independent of the presence of a second reaction zone. Thus, the comparison of example 1 with example A presented in table 1 of the patent-in-suit supported the unexpected finding that the vapour phase of the flash separation

zone was unexpectedly enriched in acetic acid in preference to the other more volatile components present in the liquid reaction composition.

Hence, the combination of the lower temperature in the first reaction zone and the higher temperature of the liquid reaction composition being passed to the flash separation zone achieved improvements to the process that would not have been obvious to a skilled person without the benefit of hindsight. The subject-matter of claim 1 of the patent as granted involved therefore an inventive step.

The subject-matter of claim 1 of the first and second auxiliary requests involved an inventive step for the same reasons as for the subject-matter of claim 1 of the main request.

- V. According to the Respondent, document (1) or document (2) could represent the closest prior art to the invention. The process of claim 1 of the patent-in-suit differed from the process disclosed in the examples of document (2) only in that the temperature of the liquid reaction composition being passed to the flash separation zone was increased by at least 8°C with respect to the temperature of the liquid reaction composition withdrawn from the first reaction zone. The comparative process of example A in table 1 of the patent-in-suit did not reflect the closest prior art document (2), since it involved a single reaction zone. Furthermore, the effect shown in table 1 of the patent-in-suit on the concentration of acetic acid in the gas phase was due to the temperature of the composition entering to the flash separation zone, but not to the difference of temperature between the composition leaving the first reaction zone and that



entering to the flash separation zone zone. Hence, the technical problem was the provision of an alternative process for producing acetic acid. Document (2) disclosed that the temperature of the second zone could be up to 30°C higher than in the first reaction zone. Hence, the claimed subject-matter of claim 1 of the main request, and for the same reason that of claim 1 of auxiliary requests 1 and 2, lacked an inventive step.

VI. The Appellant requested that the decision under appeal be set aside and that patent be maintained as granted, or subsidiarily on the basis of the first or second auxiliary request, both request being filed with the letter dated 13 July 2015.

The Respondent requested that the appeal be dismissed.

VII. At the end of the oral proceedings held on 14 February 2019, the decision of the Board was announced.

### **Reasons for the Decision**

1. The appeal is admissible.

*Inventive step*

*Main request: claim 1 of the patent as granted*

2. *Closest prior art*

Documents (1) and (2) disclose a process for the production of acetic acid comprising steps (a) to (e) as required by the process of claim 1 of the patent as granted.

The temperature of the first carbonylation reaction in the first reaction zone is preferably in the range 150 to 220°C (see document (1) on page 4, lines 1 to 3; document (2) on page 3, lines 35 and 36). The second reaction zone is preferably operated at a reaction temperature in the range of 150 to 230°C (see document (1) on page 4, lines 19 and 20; document (2) on page 2, lines 51 and 52) which may be higher than that of the first reaction zone, typically up to 20°C higher (document (1), page 4, lines 19 and 20) or up to 30°C higher (document (2), page 2, lines 52 and 53).

Both documents may represent the closest prior art to the invention, in particular, the process of examples 4 to 6 of document (2), wherein the first reactor is operated at 191.4°-191.6°C and wherein additional monoxide carbon is fed to the second reaction zone, the mid temperature of the second reaction zone being 190°C (see document (2), table 1 on page 7). As carbon monoxide is added to the second reaction zone, the exit temperature may be slightly above the mid temperature.

3. *Technical problem*

According to the appellant, the problem underlying the patent-in-suit was to provide an improved process for the production of acetic acid.

4. *Solution proposed*

According to the appellant, the solution was the process of claim 1 characterized by the combination of the two following features:  
the temperature of the liquid reaction composition withdrawn from the first reaction zone is in the range of 170 to 195°C **and**

the temperature of the liquid reaction composition passed from the second reaction zone to the flash separation zone is at least 8°C greater than the temperature of the liquid reaction composition withdrawn from the first reaction zone.

However, the first reactor used in the process disclosed in examples 4 to 6 of document (2) is operated at a temperature of 191.4-191.6°C. Therefore the temperature of the liquid reaction composition withdrawn from the first reaction zone in the process of document (2) is within the claimed range of 170 to 195°C.

Hence, the solution which is characterized by the distinguishing feature with respect to the process of document (2) is that the temperature of the liquid reaction composition being passed to the flash separation zone is higher by at least 8°C than the temperature of the liquid reaction composition withdrawn from the first reaction zone.

5. *Success*

In order to show that the problem of improving the process of producing acetic acid was solved, the Appellant referred to the comparison of the processes of example A and example 1, as shown in table 1 of the patent-in-suit.

In cases where comparative tests are chosen to demonstrate an inventive step based on an improvement, the nature of the comparison with the closest prior art must be such that it is convincingly shown that the improvement has its origin in the distinguishing feature of the invention.

The evidence upon which the Appellant relies does not satisfy this criterion, since the process of example A described in the patent specification does not use a second reactor (see [0069] of the patent-in-suit), and thus does not illustrate the process disclosed in document (2), which comprises as for the process of the patent-in-suit two reactors. For these reasons, the results described in table 1 of the patent specification do not allow a fair comparison between the closest prior art and the claimed invention.

According to the Appellant, the enrichment of the vapour phase in the flash separation zone with acetic acid was independent of the presence of a second reaction zone. Thus, the comparison presented in table 1 of the patent-in-suit supported the unexpected finding that the vapour phase of the flash separation zone was enriched in acetic acid.

The comparative data in table 1 of the patent-in-suit, show that the concentration of acetic acid in the vapour fraction is higher for a composition comprising 74.5% acetic acid arriving at the flash zone at 209.5°C rather than at 188.3°C (example A and example 1). However, the characterizing feature of the claimed process, which is the temperature **difference** between the temperature of composition being passed to the flash separation zone and the temperature of the composition withdrawn from the first reaction zone, is not reflected in this comparison. Actually, the process of claim 1 also includes the embodiment wherein the liquid reaction composition arriving at flash valve is 188°C, namely when the temperature of the composition leaving the first reaction zone is less than 180°C.

The Board therefore arrives at the conclusion that the evidence proposed by the Appellant does not show that the problem of providing an improved process was solved by the process of claim 1 of the patent as granted.

According to the Appellant, it was the combination of the two features which characterized the solution, since increasing the temperature at the flash valve permitted the reaction in the first reaction zone be carried out at a lower temperature, which provided some advantages such as an increased partial pressure of carbon monoxide resulting either in an increased rate of carbonylation or a reduction in the venting of high pressure off gas. The Respondent contested that there were advantages when decreasing the temperature of the first reaction zone, because the operating temperature of this zone depended on the choice of the catalyst.

Notwithstanding the fact that the temperature of the composition leaving the first reaction zone is not the characterizing feature of the claimed process (see point 4 above), the Appellant's alleged effects regarding operating the first reactor at lower temperatures have not been proven. In the absence of any substantiating facts and corroborating evidence, the Board cannot take such allegation into account. This argument of the Appellant must therefore be rejected as unfounded.

6. *Reformulation of the technical problem*

Since the alleged improvements lack the required experimental support, the technical problem as defined by the Appellant at point 3 above should be reformulated into the provision of an alternative process for the production of acetic acid.

7. *Obviousness*

Finally, it remains to be decided whether or not the proposed solution to this reformulated technical problem is obvious in view of the cited state of the art.

Document (2) discloses that the second reaction zone may be operated at a temperature higher than the first reaction zone, typically up to 30°C higher (see page 2, lines 52 and 53). The skilled person faced with the problem of providing an alternative process to those disclosed in examples 4 to 6 of document (2) would thus have considered operating the second reactor at temperatures up to 30°C higher than the first reactor as obvious solutions, with the consequence that the feature that the temperature of the liquid reaction composition passed from the second reaction zone to the flash separation zone is at least 8°C greater than the temperature of the liquid reaction composition withdrawn from the first reaction zone is obvious in the light of document (2).

Hence, the subject-matter of claim 1 of the main request lacks an inventive step in the light of document (2).

8. *First and second auxiliary requests*

Claim 1 of the first auxiliary request requires that the flash separation zone comprises an adiabatic flash vessel. As indicated in the decision under appeal, this feature is known from document (1) (see page 8, line 15). Claim 1 of the second auxiliary request requires that fresh carbon monoxide is introduced into the

second reaction zone. This feature is already disclosed in the process of examples 4 to 6 of document (2).

The subject-matter of claim 1 of the first and second auxiliary request lacks therefore also an inventive step.

## Order

### **For these reasons it is decided that:**

The appeal is dismissed.

The Registrar:

The Chairman:



C. Rodríguez Rodríguez

P. Gryczka

Decision electronically authenticated