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**Datasheet for the decision
of 28 June 2022**

Case Number: T 1394/19 - 3.3.05

Application Number: 08718129.3

Publication Number: 2144848

IPC: C01B15/01, C01B15/023,
C07D301/12

Language of the proceedings: EN

Title of invention:

USE OF AN AQUEOUS HYDROGEN PEROXIDE SOLUTION

Patent Proprietor:

SOLVAY SA

Opponent:

Evonik Operations GmbH

Headword:

Hydrogen peroxide solution/SOLVAY

Relevant legal provisions:

EPC Art. 54(1), 54(2), 56

Keyword:

Novelty - main request (yes)

Inventive step - main request (yes) - unexpected improvement shown

Decisions cited:

Catchword:



Beschwerdekammern

Boards of Appeal

Chambres de recours

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Case Number: T 1394/19 - 3.3.05

D E C I S I O N
of Technical Board of Appeal 3.3.05
of 28 June 2022

Appellant:

(Patent Proprietor)

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(Opponent)

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Decision under appeal:

**Decision of the Opposition Division of the
European Patent Office posted on 15 March 2019
revoking European patent No. 2144848 pursuant to
Article 101(3) (b) EPC.**

Composition of the Board:

Chairman

E. Bendl

Members:

T. Burkhardt

S. Fernández de Córdoba

Summary of Facts and Submissions

I. The patent proprietor's (appellant's) appeal lies from the opposition division's decision to revoke European patent EP 2 144 848 B1.

II. The following documents were among those discussed at the opposition stage:

D1 DE 199 36 547 A1

D3 EP 1 085 017 A1

D5 US 3,607,053 A

D6 "Epoxidation of propylene by H₂O₂ in the presence of TS-1: New experimental results", pages 1-3

F1 J. Falbe and M. Regitz, "Römpf Chemie Lexikon", 9th edition, Georg Thieme Verlag Stuttgart - New York, pages 3329-31

F5 J. R. Kolczynski *et al.*, "The Behavior of the Glass Electrode in Hydrogen Peroxide Solutions", Journal of the American Chemical Society 79, 1957, pages 531-3

III. The independent claims of the patent as granted read as follows:

"1. Use of an aqueous hydrogen peroxide solution having a hydrogen peroxide concentration [H₂O₂] expressed as % by weight of the solution and an apparent pH of from pH_{min} to pH_{max}, such that

$$\text{pH}_{\text{min}} = 3.45 - 0.0377 \times [\text{H}_2\text{O}_2]$$

$$\text{pH}_{\text{max}} = 3.76 - 0.0379 \times [\text{H}_2\text{O}_2]$$

for the manufacture of propylene oxide or epichlorohydrine by reaction between propylene or allyl chloride and hydrogen peroxide."

"2. Process for the manufacture of propylene oxide or epichlorohydrine by reaction between propylene or allyl chloride and hydrogen peroxide, wherein an aqueous hydrogen peroxide solution having a hydrogen peroxide concentration $[\text{H}_2\text{O}_2]$ expressed as % by weight of the solution and an apparent pH of from pH_{min} to pH_{max} , such that

$$\text{pH}_{\text{min}} = 3.45 - 0.0377 \times [\text{H}_2\text{O}_2]$$

$$\text{pH}_{\text{max}} = 3.76 - 0.0379 \times [\text{H}_2\text{O}_2]$$

is used."

Dependent claims 3 to 10 relate to preferred embodiments.

IV. The opposition division considered among other things the main request to lack novelty in view of D1.

V. The opponent's (respondent's) arguments, as presented in the appeal proceedings and where relevant to the present decision, can be summarised as follows:

The pH values indicated in Example 2 of D1 were conventional pH values. When converted into apparent ones, they fell within the range of claim 1. Example 2 of D1 was thus novelty-destroying for the subject-matter of claims 1 and 2.

Even if the pH values of D1 were apparent ones, *arguendo*, the subject-matter of claims 1 and 2 was not inventive in view of D1. The experimental results of document D6 could not prove an effect because of the buffering component used.

VI. The appellant's arguments are reflected in the Reasons set out below.

VII. The appellant requested that the decision under appeal be set aside and the patent be maintained as granted.

As an auxiliary measure, it requested that the patent be maintained in amended form on the basis of one of four auxiliary requests submitted with the statement setting out the grounds of appeal.

The respondent requested that the appeal be dismissed.

Reasons for the Decision

Main request

The claims of the main request are those of the patent as granted.

1. Novelty

1.1 It has not been disputed that Example 2 of D1 discloses all the features of claims 1 and 2 other than an apparent pH in the claimed range.

Indeed, this example discloses the manufacture of propylene oxide by reaction between propylene and hydrogen peroxide using an aqueous hydrogen peroxide solution.

It has also not been contested that this example discloses pH values decreasing from about 6 to about 3.4 (see Figure 2).

What has been contested, however, is the nature of these pH values.

- 1.2 In the respondent's view, the pH values of Example 2 of D1 were *conventional* ones, i.e. pH values that (only) reflected the H^+ activity (see entry for pH in F1 or curve 2 in Figure 2 of F5).

Conversion of these conventional pH values resulted in apparent pH values that overlapped with the range of claim 1 of the main request. The subject-matter of claim 1 was therefore not novel.

- 1.3 By contrast, the appellant considers that the pH values of Example 2 of D1 are *apparent* pH values as determined from the potential measured by a glass electrode. This potential, however, not only depended on the H^+ activity but also on the nature of the solvent (see for example D3, paragraph [0015], or curve 1 of Figure 2 of F5), which in D1 was an aqueous 50% H_2O_2 solution instead of pure water. For this reason, the pH values of Example 2 of D1 were above the range of claim 1.

- 1.4 The board notes that it is a prerequisite for the acceptance of lack of novelty that the claimed subject-matter is "directly and unambiguously derivable from the prior art". In other words, it has to be "beyond

doubt - not merely probable - that the claimed subject-matter was directly and unambiguously disclosed in a patent document" (Case Law of the Boards of Appeal, 2019, 9th edition ["Case Law"], I.C.4.1).

Another principle is that terms used in patent documents should usually be given their normal meaning in the relevant art, unless they have been given a special meaning in the case at issue (also Case Law, I.C.4.1).

1.5 While at first glance the terminology in D1 seems to refer to the *conventional* pH value (following the IUPAC recommendation as mentioned in F1 for example), doubts remain that the pH values of Example 2 of D1 may rather be *apparent* ones (which are then outside the range of claim 1 of the patent in suit).

- Documents do not always employ precise terminology in this regard. Thus paragraph [0027] of D3 states that a pH of 2.8 is measured with a glass electrode ("pH-Wert von 2.8 gemessen"). The absence of the qualifying term "apparent" would suggest that the conventional pH is meant. However, the last sentence in this paragraph makes it clear that the measured pH is, rather, the apparent pH. Indeed, a correction is necessary to obtain the conventional pH ("tatsächlicher pH-Wert von 4.6"). Likewise, claim 1 of D3 refers to a pH between 4 and 9.5, again without the qualifying term "apparent", but the fact that Examples 1 and 7 are comparative ones and have pH values outside the claimed range makes it clear that claim 1 of D3 specifies the apparent pH.

- A glass electrode is used in D1 (column 14, line 30). This seems to confirm that the potential measured also accounts for the nature of the solvent and not only for

the H⁺ activity (D3, paragraph [0015]). Yet D1 is entirely silent on how the measured potential is converted into a pH value. In particular, D1 neither mentions any calibration nor does it indicate any correction to account for the fact that the aqueous solution of Example 2 of D1 is not pure water but contains 50% H₂O₂.

- According to column 14, lines 23 to 24, the original 50% H₂O₂ solution in Example 2 of D1 has a pH value of 2; according to lines 24 to 29, the other 50% H₂O₂ solution having a pH value of 6 was generated from this commercial pH 2 solution by means of an additional treatment with a basic exchange resin ("durch Behandlung der kommerziellen Ware mit einem basischen Ionentauscher").

Yet several documents on file, namely D3, D5 or F5, indicate that a pH value of 2 is closer to the *apparent* pH value of a 50% H₂O₂ solution than to the conventional pH value:

		wt. % H ₂ O ₂	pH conventional	pH apparent
D3	[0027]	50.7	4.6	2.8
D5	column 5, lines 8 to 12	50		2.7
F5	Fig. 2	49.6	between 4 and 5	between 2 and 3

The respondent argued that the solution with a pH of 2 could be the result of an acid treatment. While such a treatment cannot be entirely excluded, it is not mentioned in D1 (in contrast to the treatment with a

basic ion exchange resin to obtain the solution with a pH of 6, column 14, lines 24 to 29).

Consequently, it seems at least possible that the pH values given in Example 2 of D1 are apparent ones. If this were the case the pH values would be outside the range of claim 1: while claim 1 requires an apparent pH between 1.57 and 1.87 for a 50% H₂O₂ solution, the pH in Example 2 of D1 is between about 6 and about 3.4 (Figure 2).

Hence D1 does not disclose the subject-matter of claims 1 and 2 in a direct and unambiguous manner. The subject-matter of these claims is thus novel over D1 (Article 54(1) and (2) EPC).

2. Inventive step

For the reasons set out below, the subject-matter of the claims of the main request involves an inventive step within the meaning of Article 56 EPC.

2.1 The invention relates to the use of an aqueous hydrogen peroxide solution for producing propylene oxide or epichlorohydrine and to a process for the manufacture of propylene oxide or epichlorohydrine.

2.2 The parties concur that Example 2 of D1 is the closest prior art.

Since this example also relates to the manufacture of propylene oxide from propylene and hydrogen peroxide using an aqueous hydrogen peroxide solution, it is indeed an appropriate starting point for assessing inventive step.

2.3 According to the patent in suit, the problem to be solved is to provide a use of an aqueous H₂O₂ solution and a process for the manufacture of propylene oxide or epichlorohydrine yielding improved selectivity towards oxiranes such as propylene oxide without impairing the hydrogen peroxide conversion rate (paragraph [0005]).

2.4 It is proposed to solve this problem by means of the use of claim 1 and by the process for manufacture of claim 2, characterised in that the apparent pH of the aqueous H₂O₂ solution is in the claimed range.

2.5 Experiments D6, provided by the appellant with its reply to the notice of opposition, confirm that the use of an aqueous H₂O₂ solution having an apparent pH in the claimed range yields a higher selectivity and a higher conversion rate:

Experiment "No. 1" (Table 1) has an apparent pH of 2, which is within the claimed range of between 1.9 and 2.2 in the case of a 41.2 wt.% H₂O₂ solution, and this experiment does indeed have the highest selectivity towards propylene oxide and also the highest conversion when compared to solutions with:

- a lower apparent pH ("No. 2"), and
- a higher apparent pH ("No. 3").

The respondent argued that the presence of the Na₂HPO₄·2H₂O buffer in the experiments of D6 masked the influence of the apparent pH.

This argument is however not convincing, since identical amounts of buffer are used in examples Nos. 1 to 3 of D6. More importantly, the respondent has

provided only arguments and no experimental evidence for its allegations.

There is hence no evidence on file showing that the problem was not successfully solved.

- 2.6 The respondent argued that the skilled person would use an aqueous H₂O₂ solution with a *conventional* pH of between about 6 and about 3.4 when starting from Example 2 of D1, and this would thus fall within the scope of claim 1.

However, this line of argument is an *ex post facto* analysis since there is no indication in the available prior art that an apparent pH of the H₂O₂ solution in the claimed range solves the technical problem posed.

The subject-matter of claims 1 and 2 therefore involves an inventive step within the meaning of Article 56 EPC.

- 2.7 For the same reasons, the subject-matter of the dependent claims also involves an inventive step within the meaning of Article 56 EPC.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.
2. The patent is maintained as granted.

The Registrar:

The Chairman:



A. Voyé

E. Bendl

Decision electronically authenticated