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D E C I S I O N  
of 12 April 1994

Case Number: T 0645/92 - 3.3.1

Application Number: 89201122.2

Publication Number: 0341773

IPC: C07D 307/32

Language of the proceedings: EN

Title of invention:

Process for the preparation of lactones

Applicant:

Shell Internationale Research Maatschappij B.V.

Opponent:

-

Headword:

Lactones/SHELL

Relevant legal norms:

EPC Art. 56, 111(1)

Keyword:

"Decision based on faulty considerations"  
"Offer to provide evidence for improvement at appeal stage  
(allowed)"  
"Remittal (yes)"

Decisions cited:

-

Catchword:

-



Case Number: T 0645/92 - 3.3.1

DECISION  
of the Technical Board of Appeal 3.3.1  
of 12 April 1994

**Appellant:** Shell Internationale Research  
Maatschappij B.V.  
Carel van Bylandtlaan 30  
NL-2596 HR Den Haag (NL)

**Representative:**

**Decision under appeal:** Decision of the Examining Division of the  
European Patent Office dated 23 April 1992  
refusing European patent application  
No. 89 201 122.2 pursuant to Article 97(1) EPC.

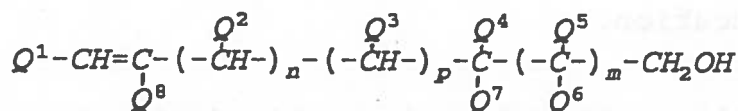
**Composition of the Board:**

**Chairman:** A. Jahn  
**Members:** J. Jonk  
R. Teschemacher

### Summary of Facts and Submissions

I. European patent application No. 89 201 122.2, filed on 28 April 1989 (publication No. 0 341 773), was refused by a decision of the Examining Division dated 23 April 1992. The decision was based on Claims 1 to 14 as originally filed, the only independent Claim 1 reading as follows:

"Process for the preparation of lactones having four or five carbon atoms in the ring or a mixture thereof, which process comprises reacting an optionally substituted alkenol, having the general formula:



in which m = 0 or 1; p = 0 or 1; n is 0 or an integer from 1 to 25; Q<sup>1</sup> represents a H atom or a C<sub>1-30</sub> alkyl group; Q<sup>2</sup>, Q<sup>3</sup>, Q<sup>4</sup>, Q<sup>5</sup>, Q<sup>6</sup>, Q<sup>7</sup> and Q<sup>8</sup> each independently represent a H atom or a C<sub>1-4</sub> alkyl group; with the provisos that: if p = 1, m = 1 and both Q<sup>7</sup> and Q<sup>8</sup> represent a H atom and at least one of Q<sup>3</sup> and Q<sup>4</sup> represents a H atom; and that if p = 0, n = 0 and Q<sup>1</sup> represents a H atom; with a carbon monoxide containing gas whereby a catalytic system is used obtainable by combining:

- (a) a palladium compound
- (b) a phosphine, arsine or stibine, and
- (c) a protonic acid having a pKa less than 2."

II. The ground for the refusal was that the subject-matter of Claim 1 lacked inventive step in the light of document

(1) EP-A-0 106 379.

The Examining Division considered that the closest state of the art with respect to the process of present Claim 1 was document (1) and that the technical problem to be solved was the provision of a more economical process for the preparation of lactones using a simple catalyst system. Furthermore, it was held that the solution to this problem was obvious to the skilled person in the light of the disclosure of this document; particularly the indication therein that the carbonylation of allyl alcohol was accompanied with esterification.

III. An appeal was lodged against this decision on 29 May 1992, and the appeal fee was paid on the same date.

A Statement of Grounds of Appeal was also submitted on this date.

Oral proceedings were held on 12 April 1994.

IV. The Appellant argued that document (1) did not provide the skilled person with any incentive to use the present catalyst system for the preparation of lactones. In this context he contended that the statement in document (1) that the carbonylation of allyl alcohol was accompanied by esterification, which has to be read in its natural meaning, would mean to the skilled person the esterification of the hydroxy group of the allyl alcohol with the carboxylic acid used as co-reactant or formed in situ during the reaction, or in the carbonylation reaction, in which the carbonylation of the starting

olefin is carried out in the presence of an alcohol, as a second alcohol substrate. In support of this contention he filed, during the oral proceedings, a comparative example which demonstrated that the carbonylation of allyl alcohol - which was the only alkenol mentioned in document (1) - in the presence of the catalyst system of the process as claimed did not provide any lactone at all.

Moreover, the Appellant argued that the closest state of the art with respect to the claimed process was the disclosure of document

- (2) EP-A-0 176 370 or document
- (3) J. Chem. Soc., Chem. Commun., 1985, pages 511 and 512,

which were both related to the preparation of lactones in the presence of the same catalyst system.

Furthermore, he argued that the catalyst system used in the process of these documents was disadvantageous due to (a) an unsatisfactory catalytic activity, (b) the requirement of the presence of oxygen which also could be derived from the disclosure of document

- (4) EP-A-0 105 704,

and (c) a restriction of the choice of suitable alkenol starting compounds. Therefore, having regard to the unexpected advantages of the present catalyst system and the fact that the cited documents did not give any incentive to the skilled person to use the catalyst system of document (1) for the preparation of lactones, the process as claimed would not have been obvious.

- V. The Board pointed out that, having regard to the disclosure of document (2) teaching that the reaction could be performed in the absence of oxygen and that starting alkenols falling under the scope of present Claim 1 could be used, the existence of the asserted advantages could not be accepted. In addition, the Board expressed its doubts whether the claimed process, in the absence of any surprising advantage, i.e. as an alternative process with respect to the closest state of the art, would involve an inventive step in the light of the combined teaching of documents (1) and (2).

Although the Appellant's Representative challenged the Board's position and took the view that the selection of the present catalyst system from the numerous known carbonylation catalysts was not obvious, he submitted that the main value of the invention resided in an increased activity of the catalyst system and asserted, relying on discussions with the inventor, that this fact could be proved.

- VI. The Appellant requested that the decision under appeal be set aside, and that the case be remitted to the Examining Division for further prosecution.
- VII. At the conclusion of the oral proceedings, the Board's decision to allow this request was announced.

#### **Reasons for the Decision**

1. The appeal complies with Articles 106 to 108 and Rule 64 EPC and is, therefore, admissible.
2. The first issue to be decided is whether the decision under appeal is right on its merits.

- 2.1 The Examining Division considered document (1) to be the closest state of the art and defined the technical problem as the provision of a more economical process for the preparation of lactones using a simple catalyst system.

However, as set out below, the Board finds that the assessment of document (1) as the closest prior art by the Examination Division was incorrect. In the Board's judgment, this mistake is not a serious one since the defined technical problem essentially corresponds to that indicated in the present patent application (cf. page 2, lines 39 to 51 and page 3, lines 22 to 25), and a proper evaluation of the cited prior art as a whole should always lead to the same judgment. However, in this context, it is noted by the Board that the flawless application of the method of assessing inventive step, i.e. the so-called problem-solution approach, which requires, as a first step, the identification of the objective technical problem in the light of the closest state of the art, has the important advantage that the risk of a judgment based on an *ex post facto* analysis can be avoided.

- 2.2 Document (1) describes a process for the carbonylation of olefinically unsaturated compounds with carbon monoxide in the presence of water, an alcohol and/or a carboxylic acid, a palladium catalyst, at least 5 mole of a triarylphosphine per gram atom of palladium, and an acid having a pKa of less than 2, with the exception of a hydrohalogenic or a carboxylic acid, as a promoter (cf. page 3, line 31 to page 4, line 4). The only products indicated are carboxylic acids, esters and carboxylic acid anhydrides (cf. page 7, line 12 to page 8, line 4, and the examples), and the document is completely silent about the production of lactones. The olefinically unsaturated alkene used as starting

compound may be a substituted or an unsubstituted alkene or cycloalkene, and suitable substituents are, for example, halogen atoms, cyano, ester, alkoxy, hydroxy, carboxy or aryl groups (vgl. page 6, lines 13 to 18). Moreover, this document discloses that, if the substituents are not inert under the reaction conditions, the carbonylation reaction may be accompanied with other reactions, and that, for instance, the carbonylation of allyl alcohol is accompanied with esterification of the hydroxy group (cf. page 6, lines 18 to 22).

2.3 The Examining Division based its finding of lack of inventive step essentially on the indication in document (1) that, in the case of the use of allyl alcohol as the starting olefin for the carbonylation reaction, the carbonylation would be accompanied by esterification, and that the skilled person, on the basis of this information, would have understood that the carbonylation of olefinic alcohols would have lead to the forming of lactones.

2.4 However, this argument fails, because the Board accepts the Appellant's submission that the skilled person, in the light of the teaching of document (1) as a whole, which is completely silent on the forming of lactones, would have interpreted this isolated statement in the sense that the carbonylation of allyl alcohol in the presence of another alcohol could lead to a side reaction in which the hydroxy group of the allyl alcohol gives an allyl ester instead of the ester of that other alcohol, or that the carbonylation of allyl alcohol in the presence of water and a further esterification reaction of the formed carboxylic acid with the allyl alcohol, again, could lead to the forming of the corresponding allyl ester. Furthermore, the skilled person would have immediately understood that, if a



carboxylic acid were used as a reaction component, the corresponding allyl ester could be formed as a by-product.

In this context, it is the Board's position, that the terms "esterification" and "esters", in their normal meaning, are concerned with straight esters, and that lactones, which may be scientifically regarded as cyclic esters, form a particular class of chemical compounds. Thus, the Board finds that, if it had been the intention of the author of document (1) to inform the reader that, in addition to straight esters, cyclic esters could also be formed as side products, he would have indicated this possibility as a separate side reaction.

Moreover, even if the skilled person were to carry out the process described in document (1) in the presence of allyl alcohol - which is the only olefinically unsaturated compound mentioned in this document which contains a hydroxy group - he could not have determined any forming of lactones as follows from the comparative example filed during oral proceedings.

2.5 Therefore, in the Board's judgment, the information given in document (1) does not lead the skilled person to suppose that the carbonylation of olefinic alcohols in the presence of the catalyst as claimed (which corresponds to that of document (1)) could be used for the preparation of lactones, let alone could solve the problem acknowledged by the Examining Division, namely, the provision of a more economical process for the preparation of lactones.

2.6 Thus, in view of the considerations above, the decision of the Examining Division that the claimed process is obvious in the light of the disclosure of document (1) is erroneous and apparently based on an unallowable ex

*post facto* analysis. Therefore, the decision under appeal cannot be upheld on the basis of these reasons.

3. As follows from the facts and submissions indicated above, particularly in section V, first paragraph, it is the Board's position that, on the basis of Claim 1 in its present scope and/or the available evidence with respect to the advantages submitted by the Appellant, the grant of a patent could not be ordered.

3.1 However, during oral proceedings, the Appellant strongly emphasised that - as indicated in the present patent application - the predominant advantage of the claimed process with respect to the known process for the preparation of lactones described in the closest state of the art, i.e. document (2), lay in the improved activity of the catalyst system and, consequently, in saving valuable noble metal. It is true that evidence in this respect has not yet been provided, but the necessity to do so was apparently only recognised for the first time during oral proceedings. Moreover, the Appellant convinced the Board that he was in a position to provide the required evidence if he were given this opportunity in further proceedings.

In these circumstances, it appeared unfair to the Board to refuse the Appellant's offer to provide the required evidence.

4. Therefore, the Board exercises its power under Article 111(1) EPC and remits the case to the Examining Division for further prosecution.

4.1 In the further examination procedure document (2) concerning the preparation of lactones, and not document (1) which is - as set out above - completely silent on the forming of such compounds, shall represent the

closest state of the art, and the results of the evidence promised in support of the alleged advantage with respect to this closest prior art shall be included in defining the technical problem to be solved by the claimed process.

4.2 Furthermore, the Board notes that the definition of the provisos in present Claim 1 should apparently read:

"that: if  $p = 1$  and  $m = 1$ , both  $Q^7$  and  $Q^8$  represent a H atom and at least one of  $Q^3$  and  $Q^4$  represents a H atom; and that if  $p = 0$  and  $n = 0$ ,  $Q^1$  represents a H atom".

**Order**

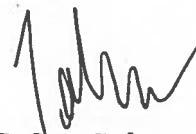
**For these reasons, it is decided that:**

1. The decision under appeal is set aside.
2. The case is remitted to the Examining Division for further prosecution.

The Registrar:

  
E. Görgmaier

The Chairman:

  
K.J.A. Jahn

