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**Datasheet for the decision  
of 22 September 2023**

**Case Number:** T 1807/20 - 3.3.02

**Application Number:** 13729903.8

**Publication Number:** 2864307

**IPC:** C07D307/68

**Language of the proceedings:** EN

**Title of invention:**

PROCESS FOR PURIFYING CRUDE FURAN 2,5-DICARBOXYLIC ACID USING  
HYDROGENATION

**Patent Proprietor:**

Eastman Chemical Company

**Opponent:**

Synvina C.V.

**Headword:**

**Relevant legal provisions:**

EPC Art. 83

RPBA 2020 Art. 11, 12(2)

**Keyword:**

Sufficiency of disclosure - (yes)

Remittal - (yes)

**Decisions cited:**

**Catchword:**



**Beschwerdekammern**

**Boards of Appeal**

**Chambres de recours**

Boards of Appeal of the  
European Patent Office  
Richard-Reitzner-Allee 8  
85540 Haar  
GERMANY  
Tel. +49 (0)89 2399-0  
Fax +49 (0)89 2399-4465

**Case Number: T 1807/20 - 3.3.02**

**D E C I S I O N**  
**of Technical Board of Appeal 3.3.02**  
**of 22 September 2023**

**Appellant:** Eastman Chemical Company  
(Patent Proprietor) 200 South Wilcox Drive  
Kingsport, TN 37660 (US)

**Representative:** Ricker, Mathias  
Wallinger Ricker Schlotter Tostmann  
Patent- und Rechtsanwälte Partnerschaft mbB  
Zweibrückenstrasse 5-7  
80331 München (DE)

**Respondent:** Synvina C.V.  
(Opponent) 29, Zekeringstraat  
1014 BV Amsterdam (NL)

**Representative:** Wurfbain, Gilles L.  
Avantium Support B.V.  
Kallenkoterallee 82A  
8331 AJ Steenwijk (NL)

**Decision under appeal:** **Decision of the Opposition Division of the  
European Patent Office posted on 22 July 2020  
revoking European patent No. 2864307 pursuant to  
Article 101(3) (b) EPC.**

**Composition of the Board:**

**Chairman** M. O. Müller  
**Members:** P. O'Sullivan  
B. Burm-Herregodts

## Summary of Facts and Submissions

- I. The appeal of the patent proprietor (hereinafter appellant) lies from the decision of the opposition division to revoke European patent 2 864 307.
- II. The contested decision was based *inter alia* on the patent as granted as main request. According to the decision, claim 1 of the main request did not fulfill the requirements of Article 83 EPC.
- III. With the statement of grounds of appeal, the appellant submitted *inter alia* that the conclusion in the contested decision in relation to sufficiency of disclosure for claim 1 of the main request was incorrect. It also submitted sets of claims as auxiliary requests 1 to 29 as well as the following documents:
- D31: "Carbonsäuren" (Wikipedia excerpt)  
D32: "Statistische Versuchsplanung" (Wikipedia excerpt)  
D33: Experimental report of M.E. Janka dated 12 December 2019, first submitted in opposition proceedings with the letter dated 13 December 2019
- IV. No reply to the statement of grounds of appeal was submitted by the opponent.
- V. With letter dated 29 January 2021, the opponent withdrew its opposition with immediate effect.

VI. Requests relevant to the present decision

The appellant requests that the contested decision be set aside, that claim 1 of the main request be found to fulfill the requirements of Article 83 EPC, and that the case be remitted to the opposition division for further prosecution.

The appellant also requested

- that the claims of auxiliary request 28 submitted before the opposition division and auxiliary request 29 submitted with the statement of grounds of appeal be admitted into the proceedings, and
- that documents D31 and D32 be admitted into the proceedings.

Having withdrawn its opposition, the opponent is not party to the present proceedings.

VII. For the text of independent claim 1 of the main request, reference is made to the reasons for the decision, below.

VIII. For the appellant's submissions in relation to sufficiency of disclosure, reference is made to the reasons for the decision, below.

## Reasons for the Decision

Main request (patent as granted)

1. Sufficiency of disclosure - Article 100(b) and 83 EPC

Claim 1 of the main request reads as follows:

*"A process for purifying a crude furan 2,5-dicarboxylic acid (cFDCA) composition comprising:*

*a) providing in an oxidation zone a cFDCA composition comprising furan 2,5-dicarboxylic acid (FDCA) solids, 5-formyl furan-2-carboxylic acid (FFCA), and a liquid oxidation solvent composition, wherein the oxidation solvent composition is an aliphatic carboxylic acid comprising a C2 to C6 monocarboxylic acid; or the oxidation solvent composition is an aqueous acetic acid solution having an acetic acid concentration of 80 to 99 wt.% before adding it to the oxidation zone; or the oxidation solvent composition as added to the oxidation zone comprises a mixture of water and acetic acid which has a water content of 0 % to 15 % by weight;*

*b) separating at least a portion of the oxidation solvent composition from the FDCA solids in the cFDCA composition in a first solid-liquid separation zone to generate a concentrated cFDCA composition comprising FDCA solids and enriched in the concentration of solids relative to the concentration of solids in the cFDCA composition fed to the first solid-liquid separation zone;*

*c) feeding the concentrated cFDCA composition to a dissolution zone in which a hydrogenation solvent composition is combined with the FDCA solids in the*

*concentrated cFDCA composition and dissolving at least a portion of said FDCA solids to thereby produce a solvated FDCA (sFDCA) composition comprising dissolved furan 2,5-dicarboxylic acid (FDCA), the hydrogenation solvent composition, and 5-formyl furan-2-carboxylic acid (FFCA), wherein the hydrogenation solvent composition comprises at least 80 wt.% water;*

*d) subjecting the sFDCA composition to a hydrogenation reaction in a hydrogenation reaction zone under conditions sufficient to cause hydrogenation of at least a portion of the FFCA in the sFDCA composition to generate a hydrogenated FDCA (hFDCA) composition comprising dissolved FDCA and the hydrogenation solvent composition; and*

*e) crystallizing the hFDCA composition in a purified crystallization zone to generate a crystallized hFDCA composition comprising liquid and FDCA solids; and*

*f) separating at least a portion of the liquid from the FDCA solids in the crystallized hFDCA composition in a second solid-liquid separation zone to thereby generate a purified FDCA (pFDCA) composition enriched in the concentration of FDCA solids relative to the concentration of FDCA solids in the crystallized hFDCA composition."*

## 1.1 Introduction

Claim 1 describes a process for purifying a crude furan 2,5-dicarboxylic acid (cFDCA) composition comprising steps a), b), c), d), e) and f). These steps can be summarised as follows:

In step a) a cFDCA composition comprising furan 2,5-dicarboxylic acid (FDCA) solids and 5-formyl furan-2-carboxylic acid (FFCA) is provided in "an oxidation zone". According to the patent, this cFDCA composition results from the reaction of 5-(hydroxymethyl)furfural (5-HMF) and/or its derivatives in the presence of an oxidation solvent, a catalyst system and a gas comprising oxygen (paragraphs [0019] -[0025]).

Step b) concerns a solid-liquid separation step to provide a concentrated cFDCA composition comprising FDCA solids, e.g. by filtration (paragraph [0062]).

In step c), the concentrated cFDCA composition, which comprises both the desired FDCA product as well as the undesired impurity FFCA, is fed to a dissolution zone and dissolved in a "hydrogenation solvent" (e.g. water, paragraphs [0086] and [0087]).

In step d), the solvated FDCA (sFDCA) composition is hydrogenated under conditions sufficient to cause hydrogenation of at least a portion of the (undesired) FFCA in the sFDCA composition, and generate a hydrogenated FDCA (hFDCA) composition. The undesired FFCA is converted to water soluble compounds which can easily be separated from FDCA (e.g. by crystallisation in step e); see paragraphs [0096] and [0097]).

In step e), the hFDCA composition is crystallised to generate a crystallized hFDCA composition comprising liquid and FDCA solids.

In the final step f), the crystallised FDCA solids are separated in a second solid-liquid separation zone to provide the purified FDCA (pFDCA) product.



1.2 The contested decision

1.2.1 The opposition division concluded that the invention defined in claim 1 of the main request was not sufficiently disclosed in view of hydrogenation step d) thereof.

1.2.2 Specifically, according to paragraph [0096] of the patent, the hydrogenation step d) was to be performed under such conditions as to reduce at least a portion of the FFCA in the sFDCA composition. However, such a process was not known from the prior art and the skilled person could not get any information from the common general knowledge in relation to the conditions under which hydrogenation of the FFCA in the sFDCA took place. Paragraph [0111] of the patent explained that during the hydrogenation process, undesired reactions took place if the hydrogenation conditions were too severe, for example if the temperature, the hydrogen partial pressure, or the catalyst loading were too high.

1.2.3 Hence, the opposition division concluded that there were too many variables to choose from in order to ensure hydrogenation of undesired FFCA and avoid the hydrogenation of the desired FDCA as described in paragraph [0111]. The patent did not describe one way of carrying out the invention, in terms of the combinations of variables required to perform the process of claim 1. Hence, the skilled person was left to find the balance in said variables. This amounted to a research project, and therefore the invention defined in claim 1 was not sufficiently disclosed.

1.3 The board's view

1.3.1 The board disagrees with this conclusion.

According to established case law, compliance with the requirements of sufficiency of disclosure is to be assessed at the priority date on the basis of the understanding of the skilled person from the patent (Article 100(b) EPC) or application (Article 83 EPC) as a whole, taking into account the common general knowledge. As noted by the appellant, a concrete example is not a prerequisite for acknowledgement of sufficiency of disclosure.

1.3.2 Hence, as stated by the appellant, it needs to be assessed in relation to step d) of claim 1, whether on the basis of the information in the patent as a whole and the common general knowledge, the skilled person would be able to carry out the hydrogenation reaction such that undesired FFCA in the sFDCA composition is selectively hydrogenated while conversion of the desired product FDCA to unwanted side products is avoided.

1.3.3 A crucial aspect of this assessment, as stated by the appellant, is that according to established case law, an allegation of lack of sufficient disclosure must be based upon serious doubts, and be substantiated by verifiable facts.

1.3.4 In the present case, the board sees no reason to doubt that the process of claim 1, in particular step d) thereof, can be carried out by the skilled person.

1.3.5 More specifically, the hydrogenation step d) is addressed in detail in the patent in paragraphs [0095] - [0112] as the fourth step of the claimed process:

- Paragraph [0095] states that the hydrogenation reaction requires "conditions sufficient to cause hydrogenation of at least a portion of the FFCA... to generate a hydrogenated FDCA composition".
- Paragraph [0096] describes in detail the products of the hydrogenation of FFCA, all of which are water soluble according to paragraph [0097].
- Paragraph [0098] states that the hydrogenation reaction is carried out under mild conditions which allow selective hydrogenation, minimising hydrogenation of the furan ring of the FDCA molecule while hydrogenating FFCA, compared to a hydrogenation conducted under higher temperature and pressure.
- Paragraph [0099] teaches that the hydrogenation should take place at a temperature lower than that of conventional hydrogenation processes. In paragraph [0100] it is stated that to avoid hydrogenating the furan ring, the partial pressure of hydrogen should be controlled at a given reaction temperature. A lower partial pressure should be selected if the reaction temperature is high, while higher partial pressures could be selected if the reaction temperature is low.
- Further guidance regarding the hydrogenation step is provided in paragraphs [0101] -[0110]).

- As noted by the opposition division and the appellant, paragraph [0111] discloses the undesirable reactions which may occur if hydrogenation conditions are too severe, namely when the temperature is too high for the residence time employed, or the partial pressure of hydrogen is too high, or the catalyst loading is too high, or a combination of these conditions.

1.3.6 In addition to the general information addressed above, as stated by the appellant, the patent also recites preferred parametric ranges for the conditions of the hydrogenation reaction, namely

- a pressure range of 50 psi to 700 psi and a temperature range of 130 °C to 180 °C (claim 8),
- a catalyst loading of preferably 0.01 wt% to 1.0 wt% (paragraph [0109]),
- a residence time of 45 minutes to 5 hours (paragraph [0104]).

1.3.7 Furthermore, as set out above, it is emphasised in the patent that the hydrogenation should be carried out under mild conditions in order to effect the transformations of the undesired by-product as set out in paragraph [0096], while at the same time avoiding severe hydrogenation conditions leading to destruction of the desired product. Such severe conditions include high temperature, partial pressure, or catalyst loading, or combinations thereof, as detailed in paragraph [0111].

1.3.8 Consequently, in line with the view of the appellant, the patent discloses how the selective hydrogenation step should be carried out.

1.3.9 On the contrary, the opposition division's conclusion that there were too many variables for the person skilled in the art to choose from to allow the achievement of the claimed purification and avoid the unwanted side products addressed in paragraph [0111], is not supported by any substantiated facts, but amounts to a mere allegation.

In the absence of any such evidence, and in view of the information available in the patent, there is no reason to believe that the skilled person would be unable to find suitable conditions required to effect the desired selective hydrogenation.

1.3.10 Furthermore, even if there were a doubt, the appellant's experimental report D33 supports the assumption that optimisation of the hydrogenation step d) of claim 1 would not amount to undue burden for the skilled person. In this report, step d) is carried out under specific conditions which correspond to the approximate midpoint of the respective preferred ranges set out in the patent as addressed above.

It was demonstrated that under said conditions, the hydrogenation reaction could be carried out in accordance with step d) of claim 1. Specifically, experiments 3 and 4 (table 1 on page 3) are carried out with a hydrogen partial pressure of 231 psi (claim 8: 50 - 700 psi), a temperature of 150 °C (claim 8: 130 to 180 °C), a residence time of 3 hours (paragraph [0104]: 45 minutes - 5 hours) and a catalyst loading of 0.5 wt% (paragraph [0109]: 0.01 - 1,0 wt%). In experiment 5,

similar results were obtained, with the decrease in hydrogen partial pressure from 231 to 185 psi being compensated by a higher temperature of 170 °C.

Consequently, the invention defined in granted claim 1 is disclosed in a manner sufficiently clear and complete for it to be carried out by a person skilled in the art (Article 83 EPC).

2. The appellant's further requests

- 2.1 The appellant requested that the set of claims of auxiliary request 28 (submitted in opposition proceedings and not admitted by the opposition division according to the contested decision) and auxiliary request 29, submitted with the statement of grounds of appeal, be admitted into the proceedings.

Both of these requests were submitted to overcome the opposition division's finding of lack of sufficient disclosure in relation to claim 1 of the main request (statement of grounds of appeal, page 3, second full paragraph - page 4, second full paragraph).

As set out above, the requirements of sufficiency of disclosure for claim 1 of the main request are met. Hence, there is no need for the appellant to overcome an objection in relation to sufficiency of disclosure. Consequently, the appellant's request to admit is moot, and there is no need for the board to decide on the admittance of auxiliary requests 28 and 29.

- 2.2 The appellant also requested that D31 and D32 submitted with the statement of grounds of appeal be admitted into the proceedings. As can be derived from the foregoing, these documents are not required in order

for sufficiency of disclosure to be acknowledged for granted claim 1. Hence, the request to admit them is moot, and there is no need for the board to decide on this issue.

3. Remittal - Article 11 RPBA 2020

As noted by the appellant, the contested decision solely addresses sufficiency of disclosure, and only specifically in relation to claim 1 of the main request. This is derivable from the first paragraph of page 5 of the contested decision referring exclusively to the process of claim 1 as granted.

According to the appellant, further objections in relation to sufficiency of disclosure were raised by the (then) opponent in the notice of opposition, in particular in relation to claims 3, 5, 7, 8 and 13 to 15 (statement of grounds of appeal, page 2, final paragraph).

Since none of these objections were addressed in the contested decision, they do not form the basis of appeal proceedings pursuant to Article 12(2) RPBA. The same applies to objections in relation to further grounds for opposition raised by the (then) opponent in opposition proceedings.

Consequently, in line with the appellant's request, the case is to be remitted to the opposition division for further prosecution.

4. Rule 84 EPC - withdrawal of the sole opposition

During further prosecution, in view of the withdrawal

of the sole opposition, the opposition division must decide pursuant to Rule 84(2) EPC whether to continue the opposition proceedings of its own motion.

The board's decision to remit the case for further prosecution should not be interpreted in such a way that it has any bearing on this decision.

## **Order**

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

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

The Registrar:

The Chairman:



M. Schalow

M. O. Müller

Decision electronically authenticated