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Datasheet for the decision of 31 August 2020

Case Number: T 2184/16 - 3.3.08

Application Number: 09710344.4

Publication Number: 2240591

IPC: C12P7/06, C12P19/00, C12M1/36

Language of the proceedings: EN

Title of invention:
METHOD OF PRODUCTION OF ETHANOL FROM TWO DIFFERENT STARTING MATERIALS

Patent Proprietor:
Sekab E-Technology AB

Opponent:
Novozymes A/S

Headword:
Ethanol production/SEKAB E-TECHNOLOGY

Relevant legal provisions:
RPBA Art. 12(4)
EPC Art. 54, 56, 83, 111(1)

Keyword:
Admission of new evidence filed in appeal (no);
Main request - meets all requirements of the EPC (yes);

Decisions cited:
G 0001/03, G 0001/15, T 1120/00, T 0870/02, T 0270/10

Catchword:

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Case Number: T 2184/16 - 3.3.08

D E C I S I O N
of Technical Board of Appeal 3.3.08
of 31 August 2020

Appellant I: (Patent Proprietor)	Sekab E-Technology AB Box 286 891 24 Örnsköldsvik (SE)
Representative:	Wirén, Anders Kransell & Wennborg KB P.O. Box 27834 115 93 Stockholm (SE)
Appellant II: (Opponent)	Novozymes A/S Krogshøjvej 36 2880 Bagsværd (DK)
Representative:	Didmon, Mark Potter Clarkson The Belgrave Centre Talbot Street Nottingham NG1 5GG (GB)
Decision under appeal:	**Interlocutory decision of the Opposition Division of the European Patent Office posted on 26 July 2016 concerning maintenance of the European Patent No. 2240591 in amended form.**

Composition of the Board:

Chairman	B. Stolz
Members:	P. Julià
	J. Geschwind

Summary of Facts and Submissions

I. European patent no. 2 240 591 is based on the European patent application no. 09 710 344.4, published under the PCT as International patent application WO 2009/102256 (hereinafter, "the patent application"). The patent was granted with 14 claims.

II. An opposition was filed on the grounds set forth in Articles 100(a), (b) and (c) EPC. The opposition division considered the main request and auxiliary requests 1 to 4 to contravene Article 123(2) EPC, and auxiliary request 5 to lack novelty (Article 54 EPC). Auxiliary request 6 was considered to fulfil the requirements of the EPC and, accordingly, the patent was maintained in amended form on the basis of auxiliary request 6.

III. Appeals were lodged by both the patent proprietor and the opponent (appellants I and II, respectively). In the statements setting out the grounds of appeal, appellant I maintained the requests underlying the decision under appeal and appellant II filed new evidence. As an auxiliary measure, both parties requested oral proceedings.

IV. In reply to the appellant II's statement of grounds of appeal, appellant I filed auxiliary request 7.

V. The parties were summoned to oral proceedings. In a communication pursuant to Article 17 of the Rules of Procedure of the Boards of Appeal, the board informed the parties of its provisional opinion on the issues of the case.

VI. Following a further exchange of correspondence between the parties and the board, appellant I reorganised its requests making former auxiliary requests 5, 6, 7 and 4 its new main request and new auxiliary requests 1, 2 and 3, respectively.

VII. Oral proceedings were held on 31 August 2020.

VIII. The main request contains two claims and claim 1 reads as follows:

"1. A method of improving the ethanol yield in production of an ethanol-containing product from a lignocellulosic biomass comprising straw and a starch-rich biomass comprising grain, comprising:

a first treatment, involving hydrolysis, of said lignocellulosic biomass in one or more steps to obtain lignocellulosic-derived treatment products including fermentable sugars and substances capable of stressing the fermenting agent comprising furfural, acetic acid and HMF; and

a second treatment, involving hydrolysis, of said starch-rich biomass in one or more steps to obtain starch-derived fermentable sugars;

fermentation, using a fermentation agent, of a mixture comprising at least part of said lignocellulose-derived treatment products and at least part of said fermentable sugars derived from said starch-rich material to obtain said ethanol-containing product,

wherein an amount of lignocellulose-derived material and an amount of material derived from the starch-rich biomass are mixed in the fermentation or earlier such

that said at least part of said lignocellulose-derived treatment products and said at least part of said starch-derived fermentable sugars are present in the mixture,

and said amounts are controlled such that said mixture comprises furfural in a concentration of 0.2 to 0.9 g/l, acetic acid in a concentration of 0.35 to 8 g/l and HMF in a concentration of 0.015 to 0.75 g/l and said fermenting agent is subjected to stress by lignocellulose-derived treatment products to the extent that said ethanol yield is improved,

wherein the hydrolysis of the first treatment comprises enzymatic hydrolysis."

Claim 2 is directed to an embodiment of claim 1.

IX. The following documents are cited in this decision:

(1): WO 2008/154468 (publication date: 18 December 2008);

(2): M.J. Taherzadeh *et al.*, Chemical Engineering Science 1997, Vol. 52, No. 15, 2653 to 2659;

(3): K. Öhgren *et al.*, Process Biochemistry 2007, Vol. 42, 834 to 839;

(11): EP-A1-2 562 262 (filing date: 10 February 2009; priority date: 11 February 2008);

(14): Declaration of Dr Jiyin (Jim) Liu, signed on 22 November 2016.

X. The appellant I's submissions, insofar as relevant to the present decision, may be summarised as follows:

Admission of document (14)

In reply to the Notice of opposition, the patent proprietor filed auxiliary requests 1 to 8 for overcoming, *inter alia*, an objection for lack of novelty over document (1). Some of these auxiliary requests comprised claims with a feature defining the concentration ranges of acetic acid, furfural and HMF (5-(hydroxymethyl)furfural). Claim 1 of auxiliary requests 7 and 8 comprised this feature which was also present in the auxiliary requests filed in reply to the opposition division's preliminary opinion and in preparation of the oral proceedings at first instance. The relevance of these ranges for distinguishing the claimed method from that disclosed in document (1) was evident from the earlier stages of the opposition proceedings and thus, the evidence disclosed in document (14) should have been filed at first instance. It was the opponent's burden to provide evidence for supporting the allegation that these ranges were implicitly disclosed in Example 1 of document (1). Moreover, the evidence disclosed in document (14) was complex and based on several assumptions that, *prima facie*, rendered it not relevant.

Main request
Novelty

The materials of the starting mixture disclosed in Example 1 of document (1) (corn stover/corn mash) were different from those required in the method of claim 1 (straw/grain). Document (1) disclosed a long list of lignocellulose-containing materials - as different as

bagasse, paper and pulp processing waste, municipal solid waste and industrial organic waste - and a long list of starch-containing materials, wherein whole grains and milled whole grain were just one option among many other possible starch-containing materials. The combination of straw and grain required a selection from two independent lists which, according to the case law, represented novel subject-matter and thus, was not directly disclosed in document (1). The less so, because neither straw nor grain was singled out as a preferred starting material in document (1).

Moreover, the concentration of acetic acid, furfural and HMF derived from the lignocellulosic biomass depended on the lignocellulosic material selected as well as on the amount (wt.%) and specific pretreatment carried out with this material. The information disclosed in Example 1 of document (1) as regards corn stover pretreatment was not enough to equate it with the conditions of the wheat straw pretreatment disclosed in Example 1 of the patent; there was no indication of the level of dilution of the pretreated corn stover (PCS) filtrate and of the corn stover amount (wt.%) in the combined fermentation medium. The acetic acid concentration indicated in Table 1 of document (1) was the concentration in the PCS filtrate but not in the combined fermentation medium. Therefore, the results disclosed in Example 1 of the patent for wheat straw/wheat grain did not directly apply to the corn stover/corn mash and the conditions used in Example 1 of document (1). The concentration of acetic acid, furfural and HMF was neither disclosed in Example 1 of document (1) nor directly derivable from the results provided in Example 1 of the patent. Thus, there was no certainty that the concentrations of these

factors in the combined fermentation medium were within the ranges defined in claim 1.

Remittal to the fist instance

Except for the absence of the disclaimer, the main request was identical to auxiliary request 6 at first instance; a request for which the opposition division examined the requirements of Articles 56 and 83 EPC and took a decision thereupon. The requirements of Article 83 EPC were considered to be fulfilled, not due or thanks to the disclaimer, but despite the disclaimer which excluded the sole subject-matter exemplified in the patent ("wherein grain and is not wheat flour"). The assessment of Article 56 EPC was carried out with the data disclosed in the patent and thus, the presence or absence of a disclaimer in the claims was irrelevant; the prior art and the context of the discussion on Article 56 EPC were the same with or without a disclaimer in the claims. Thus, there was no need and no reason for a remittal to the first instance for a discussion of any of these grounds of opposition.

Inventive step

Document (1) disclosed a long list of both, the lignocellulose- and the starch-containing materials used in the starting mixture of the method for producing ethanol. For the lignocellulose-containing material, it was stated that any material containing lignocellulose could be used and a broad range of materials were disclosed. Although straw was mentioned, there was neither a pointer nor an indication that it was a preferred material and the method was exemplified only with corn stover. The selection of straw as lignocellulose-containing material was neither the

result of a "one-way-street" situation nor obvious from either document (1) alone or its combination with other prior art on file. Indeed, there was no reason to change any of the materials used in the starting mixture disclosed in Example 1 of document (1) and, in particular, to replace the (lignocellulose-containing material) corn stover by straw.

Document (1) disclosed also a long list of factors derived from the lignocellulose-containing material that could stress or inactivate the fermenting agent. The presence of these factors depended on the actual lignocellulose-containing material used and the pretreatment method of this material. Acetic acid, furfural and HMF were cited in this list but there was neither a pointer to nor an indication of their relevance. There was no information in Example 1 of document (1) on the concentration of these three factors in the combined fermentation medium. Table 1 of document (1) indicated the acetic acid concentration in the pretreated corn stover (PCS) filtrate, but not in the combined fermentation medium. The concentrations of these three factors could not be directly derived from the information provided in the patent because both, the lignocellulose-containing material and the pretreatment method of this material, in document (1) and in the patent, were different.

According to document (1), the advantage of the disclosed method was that the pretreated lignocellulose-containing material could be used without washing or removing the stressing factors; these factors had no negative impact on the ethanol yield. There was however no indication or reference in document (1) to any improvement in the production of ethanol. Thus, the skilled person was informed that the

method disclosed in document (1) could neutralise the effect of the stressing factors but there was no teaching as regards an improvement in the production of ethanol. In this sense, document (1) taught away from the claimed method, and the improvement in ethanol yield provided by the claimed method was a surprising effect, not expected by the skilled person. Although several concentrations (wt.%) of lignocellulose-containing material were mentioned in document (1), there was no reason for a skilled person to modify the method disclosed in this document for obtaining improved ethanol yields. Nor was such a motivation derivable from Example 1 of document (1).

The method of claim 1 was neither obvious from document (1) alone nor from its combination with any of documents (2) or (3). None of these combinations were mentioned in appellant II's statement of grounds of appeal and therefore, arguments based on any of these combinations were late filed and should not be admitted into the proceedings. Although document (2) disclosed that low concentrations of acetic acid improved the ethanol yield, the method disclosed in this document was different from that of document (1); it was not based on a mixture of lignocellulose- and starch-containing materials and the fermenting agent (*Saccharomyces cerevisiae*) was cultivated in a defined medium. There was no reason for a skilled person to change the acetic acid concentration in the method of document (1), let alone for the purpose of obtaining improved ethanol yields. The method of document (3) was also different from that of document (1) because only a lignocellulose-containing material (corn stover) was used. Moreover, whilst the method disclosed in Example 1 of document (1) was based on simultaneous saccharification and fermentation (SSF) with unwashed,

undetoxified lignocellulose-containing material, document (3) stated that, when this material was washed and detoxified, the ethanol yield was much higher in a separate hydrolysis and fermentation (SHF). This was in line with the teaching of document (1), namely that removal (wash, detoxify) of the stressing factors derived from the lignocellulose-containing material resulted in improved ethanol yields. Thus, document (3) provided the skilled person with an obvious alternative for improving ethanol yields and led the skilled person away from the method of claim 1. Furthermore, there was no information in document (3) regarding the optimal concentration range for each of the three specific stressing factors mentioned in claim 1.

Sufficiency of disclosure

Document (2) showed that *S. cerevisiae* did not grow at a concentration of acetic acid of 5 g/L. However, there was no information on the ability of *S. cerevisiae* to produce ethanol at this concentration of acetic acid. Growth and fermentation were two different processes; although there was no growth, the fermenting agent could still produce ethanol by fermentation. The absence of growth could even be advantageous because less sugar was used for growth and more for fermentation and ethanol production. The patent also acknowledged a first effect of the stressing factors on the growth of the fermenting agent and, only afterwards, on the ethanol yield.

XI. The appellant II's submissions, insofar as relevant to the present decision, may be summarised as follows:

Admission of document (14)

Document (14) was filed with the statement of grounds of appeal and thus, at the earliest stage of the appeal proceedings. This was the first opportunity for appellant II to reply to the opposition division's comments in the decision under appeal on the relevance of the concentration ranges of acetic acid, furfural and HMF for establishing novelty over document (1). The relevance of these ranges was addressed for the first time at the oral proceedings at first instance and only under Article 56 EPC. The opposition division did not address them, neither under Article 54 EPC nor under Article 56 EPC, in its preliminary opinion, even though the opponent had referred to them under Article 56 EPC in response to the filing of auxiliary requests with claims comprising these ranges. The opponent had stated that these ranges merely reflected the values that resulted as an inevitable consequence of carrying out the method described in Example 1 of document (1), as supported by the disclosure of the opposed patent. This had not been contested and therefore, there had been no need for the opponent to provide any further evidence.

Main request

Novelty

Document (1) disclosed a method for producing ethanol based on the combination of a lignocellulose-containing material and a starch-containing material, and with method-steps identical to those of claim 1. Although corn stover and corn mash were used in Example 1, document (1) stated that the lignocellulose-containing material could be any material containing lignocellulose, straw being a preferred material. Likewise, the starch-containing material was not

limited to corn mash but other materials were also disclosed, including whole grains and milled whole grain; indeed, corn mash was nothing more than milled corn grain. Thus, the starting mixture used in Example 1 document (1) was identical to that of claim 1 or, if corn stover was considered not to be straw, differing only by the lignocellulose-containing material. In that case, in order to arrive at the starting materials used in the method of claim 1 (straw/grain), it was necessary to carry out only a selection from a single list (lignocellulose-containing material) and not from two lists (lignocellulose- and starch-containing material) as stated by the opposition division, and document (1) contained several pointers towards straw.

The corn stover pretreatment described in Example 1 of document (1) was identical to that carried out with straw pieces described in Example 1 of the patent. When starting with the lignocellulose-containing material in the preferred amount disclosed in document (1), namely around 50 wt.% of the total weight of the combined fermentation medium, the concentration of acetic acid, furfural and HMF had to be inevitably within the broad concentration ranges defined in claim 1, as shown by the patent itself. Indeed, according to Table 2 of the patent, a concentration of 50 wt.% resulted in the highest ethanol production. In line therewith, four of the mixture ratios in Table 3 of document (1) resulted in increased ethanol production. Moreover, the acetic acid concentration (5.3 g/L) indicated in Table 1 of document (1) for pretreated corn stover was within the concentration range of acetic acid defined in claim 1. Thus, the same had to apply also for the other stressing factors cited in claim 1, furfural and HMF.

Remittal to the first instance

At first instance, the main request and auxiliary requests 1 to 4 were considered to contravene Article 123(2) EPC and auxiliary request 5 not to be novel (Article 54 EPC); there was no discussion on Articles 83 and 56 EPC for any of these requests. The requirements of Articles 83 and 56 EPC were discussed only for an auxiliary request 6 that was filed at the oral proceedings once the opposition division had decided on a previously filed auxiliary request 6. These were special circumstances that made a remittal for discussion of Articles 83 and 56 EPC appropriate. The more so because auxiliary request 6 contained a disclaimer, not present in the main request in appeal, that excluded the sole subject-matter exemplified in the patent. Therefore, new issues arose, such as the formulation of the objective technical problem, whether the alleged effect was achieved across the whole scope of the claims, whether there was enough evidence on file to support said effect, etc. In line with the case law, the parties were entitled to defend their case before two instances and the remittal of this case had already been requested in the statement of grounds of appeal and the request been maintained during the proceedings.

Inventive step

The method disclosed in the closest prior art document (1) differed from that of claim 1 in the starting lignocellulose-containing material (corn stover *vs*. straw) and in the concentration ranges of the stressing factors acetic acid, furfural and HMF. According to the patent, these differences provided an improved ethanol production. However, the selection of

straw was obvious for a skilled person and, when the method of document (1) was performed using straw, the concentration of acetic acid, furfural and HMF, was inevitably within the ranges given in claim 1. Thus, the improved ethanol production was merely a bonus effect inevitably achieved by carrying out the method of document (1) using straw as the starting material.

The corn stover used as starting material in Example 1 of document (1) was not disclosed as being essential. Document (1) disclosed a list of other possible lignocellulose-containing materials. However, the skilled person being of a cautious nature would have selected, as a first choice, the material most closely similar to that exemplified in document (1). Straw was the most similar, if not identical to stover; indeed, corn stover was called corn straw in Britain.

The conditions of corn stover pretreatment described in Example 1 of document (1) were similar, if not identical, to those used for pretreating the straw in Example 1 of the patent. None of these conditions was mentioned in claim 1 and thus, none of them was essential to the claimed method. Therefore, when using straw, the most obvious alternative to corn stover, in the method disclosed in document (1), the concentrations of the stressing factors acetic acid, furfural and HMF, derived from this lignocellulose-containing material were inevitably identical to those disclosed in Example 1 of the patent. And, since the concentrations of these factors were allegedly essential for providing an improved ethanol production, the selection of straw as an obvious alternative in the method of Example 1 of document (1) provided inevitably an improved ethanol production, a bonus effect.

The more so since the beneficial effect of the stressing factors at low concentrations was known to the skilled person, such as described on pages 835 and 837 of document (3). The concentrations of acetic acid, furfural and HMF disclosed in Table 2, page 837 of document (3) were all within the ranges defined in claim 1. Document (1) disclosed also preferred concentrations of lignocellulose-containing material that were identical to those described in the patent. Thus, after selection of straw as an obvious alternative to corn stover, it was only within the normal technical abilities of a skilled person - using routine and standard practice - to optimise the amounts of starting materials and the conditions for obtaining the desired effect, namely improved ethanol production, as acknowledged also by the patent in paragraph [0016] of the description.

However, it was not possible to achieve this effect across the whole scope of the claims. Whilst the highest concentration of acetic acid defined in claim 1 was 8 g/L, document (2) reported on page 2656 (and in the abstract) that no growth of the fermenting agent (*S. cerevisiae*) was obtained when the concentration of acetic acid was 5 g/L. Moreover, document (1) reported a long list of stressing factors derived from the lignocellulose-containing material. There was no evidence on file showing that the technical effect could be achieved solely by having the concentrations of the three stressing factors defined in claim 1. Indeed, the results of Example 1 of document (1) showed an improved ethanol production which, however, did not further increase when the amounts of lignocellulose-containing material (PCS filtrate) were further increased.

Sufficiency of disclosure

Document (2) reported that the fermenting agent (*S. cerevisiae*) could not grow when the concentration of acetic acid was 5 g/L. However, the upper-end of the concentration range of acetic acid in claim 1 was 8 g/L. There was no evidence on file showing that, at this high concentration of acetic acid and with no growth, the fermenting agent could still produce ethanol. Therefore, there were serious doubts supported by verifiable facts that the technical effect, i.e. an improved ethanol production, could be achieved across the whole scope of the claims.

XII. The appellant I (patent proprietor) requested that the decision under appeal be set aside and that the patent be maintained in amended form on the basis of the main request or, in the alternative, any of auxiliary requests 1 to 3.

XIII. The appellant II (opponent) requested that the decision under appeal be set aside and that the patent be revoked.

Reasons for the Decision

Admission of document (14) into the appeal proceedings

1. Document (14) was filed by appellant II with the statement of grounds of appeal and thus, according to Article 12(3) RPBA 2020, it is part of appellant II's complete case. Since the statement of grounds of appeal was submitted before the date of the entry into force of the RPBA 2020, in the present case according to Article 25(2) RPBA 2020, the board's discretion when considering the admission of documents only filed at

the appeal stage is governed by Article 12(4) RPBA 2007.

2. In the Notice of opposition, document (1), in particular Example 1 and Table 3 of this document, was cited by the opponent as anticipating the subject-matter of the granted claims. In response thereto, the patent proprietor filed auxiliary requests 1 to 8, wherein auxiliary requests 3 to 8 comprised claims with a feature defining the concentration ranges of acetic acid, furfural and HMF as in claim 1 of the main request in appeal. In response to the Summons to attend oral proceedings and to the opposition division's preliminary opinion that document (1) - with reference to Example 1 and Table 3 - was prejudicial to the novelty of the granted claims, the patent proprietor filed a main request, auxiliary requests 1 to 5 and, shortly before the oral proceedings, auxiliary requests 6 to 9. Auxiliary requests 2 to 5, 7 and 9 comprised claims with a feature defining the concentration ranges of acetic acid, furfural and HMF as in claim 1 of the main request in appeal.

3. The relevance of document (1), in particular of Example 1 and the results shown in Table 3, was thus known to both parties from the earliest stage of the opposition proceedings. There were also auxiliary requests on file at earlier stages of the opposition proceedings with claims containing a feature that defined the concentration ranges of acetic acid, furfural and HMF and intended to establish novelty over document (1). Thus, appellant II had sufficient time and ample opportunities at first instance to provide experimental evidence for establishing the concentration of acetic acid, furfural and HMF of the preparations described in Example 1 of document (1),

i.e. the evidence allegedly provided in document (14). Therefore, the experimental evidence disclosed in document (14) could, and should, have been filed at first instance and not in appeal.

4. The fact that the opposition division in its preliminary opinion neither addressed the feature defining the concentration ranges of acetic acid, furfural and HMF nor commented on its relevance for establishing novelty over the method disclosed in Example 1 of document (1), does not relieve the opponent from its obligation to file evidence that the concentrations of these three stressing factors in the preparations disclosed in Example 1 of document (1) inevitably fell within the concentration ranges defined in the claim as early as possible. The presence of this feature in the sole independent claim of the lower ranking requests filed in reply to the Notice of opposition (auxiliary requests 7 and 8) and to the Summons to attend oral proceedings (auxiliary requests 7 and 9) was a clear indication of its relevance - and of the patent proprietor's intention to rely on it - for overcoming objections raised for lack of novelty and/or inventive step. It is not appropriate for a party to withhold or not to provide evidence supporting its allegations/assertions and to provide such evidence only at the opposition division's request or when the opposition division considers them not to be convincing.

5. Under these circumstances, the board, in the exercise of its discretion, does not admit document (14) into the appeal proceedings (Article 12(4) RPBA 2007).

Main request

6. The main request is identical to auxiliary request 5 underlying the decision under appeal and thus, it already forms parts of the appeal proceedings.

7. No objections under Articles 123 and 84 EPC were raised by appellant II, and the board has no reason to do so on its own motion.

Novelty (Article 54 EPC)

8. In the decision under appeal, the opposition division considered document (11), a divisional application of the patent application giving rise to the patent in dispute, to anticipate the subject matter of auxiliary request 5 (Article 54(3) EPC). In the statement of grounds of appeal, appellant I referred to the findings of decision G 1/15 (OJ 2017, A82) on a "poisonous divisional" and argued that document (11) cannot be cited against the main request.

9. In appeal proceedings, the objection of lack of novelty raised by appellant II is based only on document (1). This document was published on 18 December 2008 and thus, later than the priority date (11 February 2008) but earlier than the filing date (11 February 2009) of the patent. Since the opposition division considered the claimed subject matter not to be disclosed at the claimed priority date, document (1) became prior art under Article 54(2) EPC. The findings of the opposition division on the non-entitlement to the claimed priority right have not been contested in appeal proceedings.

10. The opposition division considered that the method for producing ethanol disclosed in document (1), in

particular the method described in Example 1, differs from the method of claim 1 by: i) the starting materials, and ii) the concentration ranges of the stressing factors acetic acid, furfural and HMF.

11. Whilst the lignocellulose-containing material and the starch-containing material in the method described in Example 1 of document (1) are corn stover and corn mash, respectively, the lignocellulosic biomass and the starch-rich biomass in the method of claim 1 are straw and grain, respectively.

11.1 There is no indication in Example 1 of document (1) concerning the source and the method used for preparing the (starch-containing material) corn mash. However, in the board's understanding, corn mash is obtained by smashing, crushing and/or grinding corn grain. This is in line with the reference on page 13, lines 9 to 11 of document (1) to "a more crude starch containing material comprising milled whole grain". Example 1 of the patent refers to "wheat" as the starch-biomass and to the addition of a water solution to "the dry flour", i.e. smashed, crushed and/or ground wheat, for obtaining "a slurry" which is then further treated before being mixed with the treated lignocellulosic biomass for simultaneous saccharification and fermentation (SSF) (cf. page 19, paragraph [0195] of the patent). According to the case law, the same standard must be applied when assessing the disclosure of a prior art document and that of the patent (cf. *inter alia*, T 1120/00 of 22 October 2004, point 15 of the Reasons; T 870/02 of 16 September 2004, point 6 of the Reasons; and T 270/10 of 15 January 2014, point 10 of the Reasons). In line therewith, the board considers the (starch-containing material) corn mash used in

Example 1 of document (1) to be a (starch-rich biomass) grain as defined in the method of claim 1.

11.2 The opposition division considered the lignocellulose-containing material corn stover used in Example 1 of document (1) not to be straw. Even though corn stover appears to be very similar to straw, there is no evidence on file to support the conclusion that corn stover falls under the term straw. Thus, there is no reason for the board to deviate from the findings of the opposition division as regards this issue.

11.3 Although straw is mentioned several times in the section under the heading "Lignocellulose-Containing Materials" of document (1), (rice) straw is only one out of seven other lignocellulose-containing materials defined as preferred embodiments (and which also includes combinations thereof) (cf. page 5, lines 16 to 18 of document (1)). In the absence of a clear pointer, the selection of (rice) straw for replacing the corn stover used in Example 1 is not as straightforward. Moreover, there is nothing in Example 1 of document (1) that would have prompted the skilled person to replace solely the corn stover, let alone by straw. The corn mash could equally likely be replaced by one of the other starch-containing materials (and mixtures thereof) (cf. page 12, line 27 to page 13, line 11). Both, corn stover and corn mash, could have been replaced by, for instance, the lignocellulose-containing material paper processing waste and the starch-containing material molasses, sugar cane or sugar beet.

12. According to document (1), the "starch-containing material and lignocellulose-containing material are treated in two separate streams before combining the

streams during starch saccharification, fermentation or simultaneous saccharification and fermentation. When the streams are combined the lignocellulose derived material may constitute from 0.1 to 90 wt.%, preferably 1 to 80 wt.%, such as 10 to 70 wt.%, especially 20 to 60 wt.%, such as around 50 wt.% of the total weight of the combined fermentation medium" (cf. page 4, lines 14 to 19 of document (1)). There is however no information in Example 1 of document (1) as regards the wt.% of (lignocellulose-containing material) corn stover in the combined fermentation medium. Moreover, it is known in the art that the content and composition of corn stover is quite variable and depends on different factors (region, year, crop maturity, etc.) (cf. *inter alia*, page 836, right-hand column, first paragraph of document (3)). Likewise, it is also known in the art that the presence and amount of toxic or inhibitory compounds in the lignocellulose-containing material depends not only on the actual material used but also on the pretreatment method and the specific conditions used (cf. page 4, lines 3 to 5 of document (1)). The presence of a concentration of acetic acid in the pre-treated corn stover (PCS) filtrate used in Example 1 of document (1) (5.3 g/L; see page 41, Table 1 of document (1)) falling within the range of acetic acid defined in claim 1 (0.35 to 8 g/L) does not necessarily mean that this must also be the case for the concentration of the other two stressing factors cited in claim 1, furfural and HMF. Furthermore, since the starting material (corn stover *vs*. wheat straw) and the pretreatment method and conditions used in Example 1 of document (1) are different from those used in Example 1 of the patent, the results and conclusions that may be derived from the latter are not directly and unambiguously applicable to the former.

13. Therefore, the disclosure of document (1) does not anticipate the method of claim 1 and thus, the main request fulfils the requirements of Article 54 EPC.

Remittal to the fist instance

14. The main request is identical to auxiliary request 5 underlying the decision under appeal and differs from auxiliary request 6 also underlying the decision under appeal by the absence of the disclaimer "and wherein the grain is not wheat flour" in claim 1. The disclaimer was introduced for overcoming an objection of lack of novelty over document (11) that was considered to be relevant by the opposition division. Auxiliary request 6 was filed at the oral proceedings at first instance and was fully examined by the opposition division, including the requirements of Articles 83 and 56 EPC. The opposition division considered this auxiliary request 6 to fulfil all requirements of the EPC and, accordingly, intended to maintain the patent in amended form on its basis. The reasons are provided in the decision under appeal.

15. In the statement of grounds of appeal, appellant II argued for remittal by stating that "[w]e were not given the opportunity to comment on any other grounds of opposition in respect of Auxiliary Request 5 during proceedings before the opposition division. There was no opportunity to file written submissions to that request (since it was filed at the oral proceedings) and the OD did not consider any other grounds of opposition at the oral proceedings aside from added matter, clarity and novelty".

16. Neither in the Minutes of the oral proceedings at first instance nor in the decision under appeal is there any

indication that the opponent objected to the (late) filing of auxiliary request 5, the introduction of the disclaimer and/or the filing of auxiliary request 6 at the oral proceedings. Nor is it apparent from the Minutes of the oral proceedings or the decision under appeal that the introduction of the disclaimer and the filing of auxiliary request 6 required a postponement of the oral proceedings for the opponent to prepare arguments under Articles 56 and 83 EPC.

17. Whilst, in the decision under appeal, there is a discussion on the admission of auxiliary requests 6 to 9 filed on 22 September 2015 following which they were not admitted into the proceedings, there is no such discussion for auxiliary request 5 filed on 22 September 2015 and amended auxiliary request 6 filed at the oral proceedings. Nor is it apparent from the Minutes of the oral proceedings at first instance that such a discussion ever took place.

18. In view thereof, the board considers that the opponent was prepared and willing to discuss all requirements of the EPC for both auxiliary requests 5 and 6, even though, as stated in appellant II's grounds of appeal, there was no opportunity to discuss Articles 56 and 83 EPC for auxiliary request 5 because it was considered to lack novelty (Article 54(3) EPC).

19. Moreover, in the statement of grounds of appeal, appellant I addressed the objection of lack of novelty of auxiliary request 5 over document (11) and argued novelty over this document. Appellant I further provided a complete problem and solution approach - with document (1) as the closest prior art - for arguing on the inventiveness of auxiliary request 5. This approach has been on file since the earliest stage

of the appeal proceedings and is similar to the assessment of inventive step by the opposition division for auxiliary request 6 underlying the decision under appeal.

20. The board does not share the appellant II's view that the absence of the disclaimer results in new issues that require a reformulation of the objective technical problem and/or in considerations of the scope of the claims and sufficiency of disclosure that are significantly different from those arising from auxiliary request 6 comprising the disclaimer. The closest prior art document, namely document (1), and other relevant prior documents, such as documents (2) and (3), are the same regardless of the presence or absence of the disclaimer, and sufficiency of disclosure is assessed taking into consideration the whole disclosure of the patent application. Appellant II's arguments put forward in both, the statement of grounds of appeal and at the oral proceedings before the board, are of a generic nature and not convincing.

21. Therefore, the board, in the exercise of its discretion (Article 111(1) EPC), does not remit the case to the opposition division.

Inventive step (Article 56 EPC)

22. It is common ground between the parties that the closest prior art is document (1). The differences between the method of ethanol production disclosed in this document, in particular the method described in Example 1, and the method of claim 1 are discussed above under Article 54 EPC.

23. Starting from this prior art, the objective technical problem is the provision of a method for improving the production of ethanol. The method of claim 1 solves this problem. Experiments 2 to 5 in Table 2 of Example 1 of the patent were performed according to the method of claim 1 and show increased ethanol yields relative to the reference experiment 1.

24. With reference to document (2) which states that in anaerobic batch conversion of glucose to ethanol by *Saccharomyces cerevisiae* "acetic acid should not exceed 5 g/l in the medium for growth to occur", appellant II argues that the technical problem is not solved across the whole scope of claim 1 because the upper-end of the acetic acid range defined in the method of claim 1 exceeds this value (8 g/l). The board observes that, in the present case, the technical effect (improved ethanol yield) is expressed not only in the preamble of claim 1 ("a method of improving the ethanol yield ...") but is also used to define a step of the claimed method ("said amounts are controlled ... to the extent that said ethanol yield is improved"). According to the established case law, if an effect is expressed in a claim, an alleged lack of reproducibility is to be treated under sufficiency of disclosure (Article 83 EPC), and not as a problem of inventive step (Article 56 EPC) (cf. G 1/03, OJ 2004, 413, point 2.5.2 of the Reasons). Therefore, the method of claim 1 is considered to solve the technical problem as formulated above and, indeed, across the whole scope of the claim.

25. As stated above under Article 54 EPC, there is no indication or pointer in document (1) that would have directed a skilled person to select straw as the preferred starting lignocellulose-containing material

and to replace the corn stover used in Example 1 of document (1) for straw (cf. point 11.3 *supra*). Moreover, as stated also above under Article 54 EPC, nothing in Example 1 of document (1) would have prompted the skilled person to replace solely the corn stover. The corn mash could have also been replaced by other alternative starch-containing materials; both, corn stover and corn mash, could have been replaced by starting materials different from straw and grain. In view of the long lists of both, lignocellulose-containing materials and starch-containing materials, disclosed in document (1) (cf. page 5, lines 3 to 24, and page 12, line 32 to page 13, line 2), the skilled person was not faced with a "one-way-street" situation leading to a combination of straw (lignocellulose-containing material) and grain (starch-containing material) (cf. "Case Law of the Boards of Appeal of the EPO", 9th edition 2019, I.D.10.8, 270; in the context of a surprising or bonus effect). Thus, the selection of straw and grain as starting materials is not obvious from document (1) alone, let alone with the expectation of improving ethanol yields.

26. Although the method described in Example 1 of document (1) results in a slight increase in ethanol yield (101%; see page 42, Table 3), there is no reference in document (1), not even in Example 1, to the disclosed method providing any improvement in the production of ethanol. Document (1) states only that "one of the advantages of the invention is that the pretreated lignocellulose-containing material may be undetoxified, i.e. the pretreated lignocellulose-containing material may contain compounds that could be toxic to the fermenting organism" (cf. page 3, lines 29 to 32). The teachings of document (1) are not directed to improving the ethanol yield but to avoiding a

negative impact on said yield when integrating the fermentation of a (pretreated) lignocellulose-containing material (corn stover; PCS liquor/filtrate) into the fermentation of a starch-containing material (corn mash) (cf. page 3, lines 4 to 6). As stated in the decision under appeal, albeit in the context of auxiliary request 6, the aim in document (1) is not to optimise ethanol production but rather to simplify the ethanol production.

27. Appellant I has argued that, since auxiliary request 5 (main request in appeal) was not attacked under Article 56 EPC in appellant II's statement of grounds of appeal and the combination of document (1) with documents (2) or (3) was not mentioned therein, these lines of attack were late filed and should not be admitted into the appeal proceedings.

28. In the decision under appeal, the opposition division referred to the combination of the closest prior art document (1) with documents (2) and (3) in the assessment of the conformity of auxiliary request 6 with Article 56 EPC. The combination of documents (1) and (3) was mentioned in appellant II's statement of grounds of appeal as rendering auxiliary request 6 obvious, and document (2) was discussed therein under Article 83 EPC to substantiate serious doubts that the claimed method could be performed across the entire scope of the claim. In view thereof and of the differences between auxiliary requests 5 (main request in appeal) and 6, the board sees no reason for considering the combination of document (1) with documents (2) or (3) as late filed and not admissible into the appeal proceedings. For the reasons given above when deciding on whether or not to remit the case to the opposition division, the board decides to admit

inventive step attacks against auxiliary request 5 based on combinations of the closest prior art document (1) with any one of documents (2) and (3).

29. Document (2) is concerned with the effect of the concentration of acetic acid on the anaerobic batch conversion of glucose to ethanol by *S. cerevisiae*. There is no reference to the (fermentation) starting material being anything else but D-glucose and there is no indication that the disclosure of this document could have prompted a skilled person to use a combination of lignocellulose-containing material (straw) and starch-containing material (grain) as starting materials for a method of producing ethanol. Indeed, document (2) has not been cited in appeal proceedings as providing the skilled person with such a motivation, but only as evidence that the method of claim 1 cannot be performed across the entire scope of the claim. However, this issue is addressed elsewhere in the present decision (*infra*, under Article 83 EPC).

30. Document (3) refers to bio-ethanol produced from corn grain (starch) and sugar cane (sucrose) as being currently the most common renewable fuel and to the fact that the large-scale use of bio-ethanol will require the use of lignocellulosic biomass as raw material. Although several examples of lignocellulosic biomass are mentioned, namely straw, sugar cane bagasse and stover (cf. page 834, left and right-hand columns), all experiments disclosed in this document are carried out using corn stover. Document (3) compares the production of ethanol from steam-pretreated corn stover by simultaneous saccharification and fermentation (SSF) and by separate hydrolysis and fermentation (SHF). It does not provide any motivation for a skilled person to replace corn stover by straw. In this sense,

document (3) does not go beyond the list of alternative lignocellulose-containing materials mentioned in document (1) (cf. page 5, lines 10 to 24 of document (1)). Therefore, the combination of the closest prior art document (1) with document (3) does not render the selection of straw and grain - as lignocellulose-containing and starch-containing (starting) materials, respectively - obvious.

31. Document (3) has also been cited as informing the skilled person of the positive effect of low concentrations of some stressing factors - derived from the pretreated (lignocellulose-containing) corn stover - on the fermenting agent (yeast) and the ethanol yield in SSF (cf. page 835, left-hand column, second paragraph). In particular, reference was made to a low concentration of acetic acid (cf. page 837, left-hand column, first paragraph) and to the concentrations of acetic acid, HMF and furfural (Table 2 on page 837), all of them falling within the concentration ranges defined in claim 1 for these stressing factors.

32. However, document (3) acknowledges also that the composition of corn stover is within the normal range and "is quite wide since the content of corn stover tends to differ depending on region, year, crop maturity, etc." (cf. page 836, right-hand column, first paragraph). Indeed, the composition of the lignocellulosic-containing material and thus, the concentration of stressing factors derived from the pretreatment of this material, differs not only from batch to batch of the selected material itself, as in the case of the corn stover exemplified in document (3), but, and even more, among different lignocellulosic materials. This is also explicitly acknowledged in document (1) which further adds that

the presence of these stressing factors "depends also to a large extent on the pretreatment method used" (cf. page 4, lines 3 to 5).

33. In view thereof, it is questionable whether a skilled person would have arrived in an obvious manner at the specific concentration ranges defined in claim 1 for the stressing factors acetic acid, furfural and HMF based on the teachings of document (1) alone or in combination with those of document (3). Both documents exemplify solely corn stover as the lignocellulosic-containing starting material, and document (3) does not even disclose a mixture of lignocellulose-containing material with starch-containing material. The board is not convinced by appellant II's arguments. The less so since, starting from document (1), a skilled person would have been prompted to select concentration ranges of stressing factors showing "no negative impact on the ethanol yield" (cf. page 3, lines 4 to 7 of document (1)), because, as stated above, there is no indication in document (1) that could have led the skilled person to expect an improvement in ethanol yield.

34. Therefore, the main request fulfils the requirements of Article 56 EPC.

Sufficiency of disclosure (Article 83 EPC)

35. It is not contested that Example 1 of the patent application exemplifies the method of claim 1 and provides information on the concentration of the stressing factors acetic acid, furfural and HMF, that result in improved ethanol yields when using a mixture of wheat straw and wheat grain as starting lignocellulosic biomass and starch-rich biomass,

respectively (cf. page 49, Table 2 of the patent application). Further detailed information is provided in the description of the patent application.

36. Claim 1 requires the claimed method to provide an improved ethanol yield, not only by defining the purpose of the method in the preamble of the claim, but also by explicitly requiring to control the concentration of the stressing factors acetic acid, furfural and HMF. Claim 1 requires to control the amounts of these factors in the mixture so that "said ethanol yield is improved". Therefore, concentrations of these three stressing factors (and mixtures thereof) which, even though falling within the concentration ranges defined in claim 1, do not result in an improved ethanol yield are not comprised, and do not fall, within the scope of claim 1. Means and methods for controlling the concentrations of these three stressing factors are known and available to the skilled person and do not require undue burden from the skilled person.

37. Although document (2) discloses that, when the concentration of acetic acid in the medium exceeds 5 g/l, no growth of the fermentation factor (*S. cerevisiae*, in anaerobic batch conversion of glucose to ethanol) was obtained within 24 hours, the scope of claim 1 does not comprise methods of producing ethanol at every concentration of the stressing factors falling within the ranges defined in this claim, but only at those concentrations that result in an improved ethanol yield. Moreover, there is no evidence on file showing that there is no production of ethanol at concentrations of acetic acid exceeding 5 g/l, even though there is no growth of the fermentation factor at those concentrations of acetic acid. In any case and

regardless of whether or not the ethanol production is continued when growth of the fermenting agent is stopped, a concentration of acetic acid exceeding 5 g/l, such as the upper-end of the acetic acid range defined in claim 1 (8 g/l), falls within the scope of claim 1 only if it results in an improved ethanol yield. As stated above and supported by document (2) itself, neither the control and measurement of the acetic acid concentration nor the detection of an improved ethanol yield require undue burden from the skilled person.

38. Thus, the board sees no reason to deviate from the findings of the opposition division and considers the requirements of Article 83 EPC to be fulfilled by the main request.

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 with the order to grant a patent on the basis of the main request (fifth auxiliary request filed on 22 September 2015) and a description to be adapted thereto.

The Registrar: The Chairman:

L. Malécot-Grob B. Stolz

Decision electronically authenticated