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**Datasheet for the decision
of 19 November 2019**

Case Number: T 1665/18 - 3.3.03

Application Number: 11007752.6

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Language of the proceedings: EN

Title of invention:

Method of preparation of alcohols, organic acids, proteins,
sugars, hydrocarbons, and mixtures thereof from biomass

Applicant:

Xyleco, Inc.

Relevant legal provisions:

EPC Art. 56

Keyword:

Inventive step - (no)



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Case Number: T 1665/18 - 3.3.03

D E C I S I O N
of Technical Board of Appeal 3.3.03
of 19 November 2019

Appellant: Xyleco, Inc.
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Decision under appeal: **Decision of the Examining Division of the
European Patent Office posted on 12 January 2018
refusing European patent application No.
11007752.6 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman F. Rousseau
Members: D. Marquis
C. Brandt

Summary of Facts and Submissions

- I. The appeal lies with the decision of the examining division posted on 12 January 2018 refusing European patent application No. 11007752.6, a divisional application of EP 07 870 818 filed on 26 October 2007.
- II. The divisional application as filed contained fifteen claims directed to a method, independent claim 1 reading as follows:
- "1. A method of producing a product, the method comprising:
converting a treated biomass feedstock to a product selected from the group consisting of alcohols, organic acids, proteins, sugars, hydrocarbons, and mixtures thereof, utilizing an enzyme and/or a microorganism, wherein the treated biomass feedstock has been irradiated with an electron beam and treated using a rotor-stator device."
- III. Following a communication pursuant to Rule 63(1) EPC on 8 June 2012, the European search opinion and the European search report were issued on 27 September 2012 in which it was indicated in accordance with the provisions of Rule 63(2) EPC that a partial search had been performed on the basis of a method for the preparation of ethanol from cellulosic and/or lignocellulosic material comprising a sonication step, an electron beam irradiation step and a conversion using a yeast. The following three documents were cited:

D1: US 2005/0026262 A1

D2: US 2005/0118692 A1

D3: WO 00/31146 A1

- IV. The decision under appeal was based on a sole claim request filed with letter of 2 June 2017.

- V. The decision under appeal considered that amended claim 1 of the main request satisfied the requirements of Article 76(1) EPC but that it did not meet the requirements of Article 123(2) EPC and that it related to unsearched subject matter contrary to the requirements of Rule 137(5) EPC.

- VI. The applicant (appellant) lodged an appeal against that decision. The appeal was based on a main request corresponding to the main request underlying the contested decision (provided with letter of 2 June 2017) and on an auxiliary request filed with the statement setting out the grounds of appeal (letter of 9 May 2018).

Claim 1 of the auxiliary request read as follows:

"1. A method of making ethanol, the method comprising: providing a material comprising a carbohydrate produced by a process comprising pretreating a biomass feedstock with electron beam radiation and sonication, wherein the biomass feedstock comprises a cellulosic and/or lignocellulosic material; and contacting the material with a microorganism having the ability to convert at least a portion of the material to the ethanol, wherein the microorganism is a yeast."

- VII. Following the Board communication sent in preparation for oral proceedings the appellant withdrew the main

request with letter of 18 October 2019.

VIII. Oral proceedings were held before the Board on 19 November 2019.

IX. The arguments of the appellant can be summarised as follows:

Inventive step

(a) The closest prior art was represented by D1. Operative claim 1 differed from the method disclosed in D1 in that electron beam radiation was used with sonication during the pretreatment of the biomass feedstock and in the use of yeast as microorganism.

(b) Examples 9 to 13 and example 16 showed that by pretreating biomass feedstock with electron beam radiation and sonication, a significant change of structure of the treated biomass could be obtained. The problem solved over the closest prior art by the method of operative claim 1 was the provision of a further method to make ethanol.

(c) D3, which disclosed a pretreatment with electron beam radiation, was not relevant since the treated material was not a cellulosic or lignocellulosic material as defined in operative claim 1. Operative claim 1 involved therefore an inventive step.

X. The appellant requested that the decision under appeal be set aside and that a patent be granted on the basis of the request filed as auxiliary request with the statement setting out the grounds of appeal (letter of 9 May 2018).

Reasons for the Decision

1. Amendments
 - 1.1 Claim 1 of the auxiliary request filed with the statement setting out the grounds of appeal finds a basis in the parent application as filed. In particular, operative claim 1 is based on claims 14, 15, 34, 36 and 39, which are dependent from one another, and on the passage of the description on page 70, lines 15-20. Accordingly, claim 1 meets the requirements of Article 76(1) EPC.
 - 1.2 The description of the divisional application contains the entirety of the description of the parent application and contains also the claims of the parent application referred to as "aspects" as part of the description on pages 130 to 139. The subject matter of operative claim 1 therefore finds a basis in the "aspects" of the divisional application and in its description. Operative claim 1 thus meets the requirements of Article 123(2) EPC.
 - 1.3 The subject matter of operative claim 1 was amended to correspond to the subject matter for which a partial European search report was performed and which is identified in the communication of the examining division dated 27 September 2012 (point 1) as a method for the preparation of ethanol from cellulosic and/or lignocellulosic material comprising a sonication step, an electron beam irradiation step and a conversion step using a yeast. Operative claim 1 thus does not relate to unsearched subject matter and therefore meets the requirements of Rule 137(5) EPC.

2. Novelty

2.1 Among the three documents D1-D3 cited in the European search report, D1 and D2 do not disclose the use of electron beam radiation and D3 does not disclose a method to make ethanol according to operative claim 1. The subject-matter of operative claim 1 is thus novel over the cited prior art.

3. Inventive step

Closest prior art

3.1 The present application relates to processing biomass and products made therefrom and in particular, to materials that can be more readily utilized by a variety of microorganisms to produce useful products, such as hydrogen, alcohols (e.g., ethanol or butanol), organic acids (e.g., acetic acid), hydrocarbons, co-products (e.g., proteins) or mixtures of any of these (page 1, line 9 and passage bridging pages 1 and 2). The method of operative claim 1 is more specifically directed to the production of ethanol.

3.2 D1 relates to methods for digesting cellular matter and in particular, to a method of sonication-enhanced digestion of cellular matter to increase biogas and biofuel production (paragraph 2) such as ethanol (paragraph 25). Since D1 uses cellular matter for the production of a source of energy, it relates to the same type of treatment of biomass feedstock as disclosed in the present application. D1 is thus in the same technical field as the present application and is a reasonable starting point for the assessment of inventive step. D1 was also acknowledged as representing the document of the closest prior art by

the appellant.

Distinguishing features

- 3.3 The method disclosed in paragraphs 27 and 28 of D1 comprises adding cellular matter to a bioreactor wherein the cellular matter is subjected to sonication in a pretreatment step.
- 3.4 The cellular matter of the methods of D1 covers as described in paragraph 25 a large group of cellular matter known to one skilled in the art to produce energy. Among the types of cellular matter considered in D1 is lignocellulose (claim 15) as defined in operative claim 1.
- 3.5 Disruption of cellular matter in the method of D1 is achieved by sonication using a sonic energy source for a sufficient amount of time to disrupt suspended solid particles in the cellular matter and even breaking apart organic polymers and cellular membranes (paragraph 27). The pretreatment step disclosed in D1 is thus similar to that disclosed in the application in its function since the pretreatment according to the application is also meant to change the molecular structure of the biomass feedstock (page 1, lines 22-23). D1 however does not disclose irradiation with electron beam radiation alongside sonication as defined in operative claim 1.
- 3.6 Following sonication according to the method of D1, the cellular matter is microbially digested for a time sufficient to anaerobically digest the cellular matter and produce biogas and biofuel (paragraph 27 and claim 1). The term microbes within the meaning of D1 includes fungi (paragraph 35). Yeast as a type of fungi

in the digestion step is however not explicitly mentioned in D1.

- 3.7 It is apparent from the above points 3.3 to 3.6 that the method according to operative claim 1 differs from the method disclosed in paragraphs 27 and 28 of D1 in the selection of lignocellulose as cellular matter for producing ethanol, the use of electron beam radiation in addition to sonication and the selection of yeast for digesting the disrupted cellular matter.

Problem successfully solved

- 3.8 With regard to the effect of using electron beam radiation in combination with sonication, the appellant pointed to examples 9 to 13 and 16 of the application as filed.

- 3.8.1 Examples 9 to 13 show the changes in molecular weight, crystallinity, porosity and BET surface area of biomass feedstock samples submitted to electron beam radiation, to a combination of electron beam radiation and sonication as compared to untreated samples. There is however in these examples no valid comparison of biomass feedstock samples only submitted to sonication.

- 3.8.2 Example 16 shows scanning electron micrographs of untreated, irradiated and/or sonicated switchgrass samples (page 113 and Fig. 32-36). It is however apparent from the description on page 113 that example 16 does not contain a sample that was submitted to sonication only. There is therefore in example 16 no sample that could represent the method of the closest prior art D1 in a comparison with other pretreatments.

3.8.3 Accordingly, examples 9 to 13 and 16 cannot establish that the combination of electron beam radiation and sonication defined in operative claim 1 provides any advantage with respect to sonication alone as disclosed in the closest prior art.

3.9 In addition, it was acknowledged at the oral proceedings that the selection of yeast from the microbes within the meaning of D1 in the method of producing ethanol was not associated with the achievement of any technical effect. Indeed, neither the passage on pages 87-91 nor the examples 19 and 20 of the application disclosing the use of yeast as a microorganism show that an improvement was obtained over D1.

3.10 There is also in the application as filed no evidence that selecting cellulose or lignocellulose over the other biomass feedstock types disclosed in the application as filed in a method for making ethanol would lead to any particular improvement of the general process disclosed in D1.

3.11 Under these circumstances, the only problem that can be derived from the application as filed is the provision of a further method for making ethanol, which was acknowledged by the appellant.

Obviousness of the solution

3.12 It remains to be established whether or not the solution to the above problem, i.e. the selection of cellulosic and/or lignocellulosic materials, the use of electron beam radiation in addition to sonication in the pretreatment step and the use of yeast was obvious

to the skilled person in view of the prior art.

- 3.13 In case of the existence of more than one distinguishing feature over the closest prior art and in the absence of any synergistic effect resulting from their combination, it has to be examined whether each of these features, taken alone, would be derivable from the prior art.
- 3.14 The use of lignocellulose for the production of ethanol as biofuel is mentioned in D1 (claim 15). Its use for solving the problem defined in above point 3.11 was therefore obvious to the skilled person.
- 3.15 In the closest prior art D1, the anaerobic digestion of the cellular matter follows a step of pretreatment of the cellular matter by sonication for a sufficient amount of time to disrupt suspended solid particles in the cellular matter as well as disrupt and breakdown the cellular matter into smaller subunits (paragraph 27). It is the production of smaller subunits of cellular matter as a result of that disruption which allows the anaerobic digestion to take place and the production of biogas and biofuel.
- 3.16 While sonication is the method of disrupting cellular matter in D1, the appellant acknowledged during the oral proceedings that electron beam radiation was another method known in art to be effective at breaking down or depolymerizing cellulosic material, which in view of its operative costs was not frequently used. An indication that this method was known in the art is also given on page 48 of the present application by reference to Bouchard, et al, Cellulose (2006), 13, 601-610. A skilled person would thus have known that electron beam radiation would at least be usable

alongside sonication for the pretreatment of cellular matter such as lignocellulose as disclosed in D1. Under these circumstances, the use of electron beam radiation in the method disclosed in D1 merely to provide a further method was obvious to the skilled person.

3.17 The microbes used to anaerobically digest the cellular matter are, within the meaning of D1, those described in paragraph 35 and include fungi. The skilled person with a view to provide a further method for making ethanol would be prompted to use specific types of fungi such as strains of yeast conventionally used in the art for ethanol fermentation. Therefore, the use of yeast within the method generally disclosed in D1 was also obvious to the skilled person.

3.18 In view of the above, the measures constitutive of the claimed solution being obvious, the skilled person would arrive in an obvious manner at the subject matter of present claim 1.

3.19 The Board thus comes to the conclusion that operative claim 1 does not meet the requirements of Article 56 EPC.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar:

The Chairman:



B. ter Heijden

F. Rousseau

Decision electronically authenticated