

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

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PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43bis.1)

Date of mailing
(day/month/year)

06 DEC 2018

Applicant's or agent's file reference
37447.0046P1

FOR FURTHER ACTION

See paragraph 2 below

International application No.

PCT/US 18/52966

International filing date (day/month/year)

26 September 2018 (26.09.2018)

Priority date (day/month/year)

26 September 2017 (26.09.2017)

International Patent Classification (IPC) or both national classification and IPC
IPC(8) - C07H 1/08; C07H 3/02; C08H 8/00; C12P 19/02 (2018.01)
CPC - C07H 1/08; C07H 3/02; C08H 8/00; C12P 19/02

Applicant RENMATIX, INC.

1. This opinion contains indications relating to the following items:

- Box No. I Basis of the opinion
- Box No. II Priority
- Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- Box No. IV Lack of unity of invention
- Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement
- Box No. VI Certain documents cited
- Box No. VII Certain defects in the international application
- Box No. VIII Certain observations on the international application

2. FURTHER ACTION

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1bis(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

Name and mailing address of the ISA/US
Mail Stop PCT, Attn: ISA/US
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Date of completion of this opinion

21 November 2018

Authorized officer

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Box No. 1 **Basis of this opinion**

1. With regard to the **language**, this opinion has been established on the basis of:
 - the international application in the language in which it was filed.
 - a translation of the international application into _____ which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).

2. This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43*bis*.1(a)).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of a sequence listing:
 - a. forming part of the international application as filed:
 - in the form of an Annex C/ST.25 text file.
 - on paper or in the form of an image file.
 - b. furnished together with the international application under PCT Rule 13*ter*.1(a) for the purposes of international search only in the form of an Annex C/ST.25 text file.
 - c. furnished subsequent to the international filing date for the purposes of international search only:
 - in the form of an Annex C/ST.25 text file (Rule 13*ter*.1(a)).
 - on paper or in the form of an image file (Rule 13*ter*.1(b) and Administrative Instructions, Section 713).

4. In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that forming part of the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

5. Additional comments:

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Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

The questions whether the claimed invention appears to be novel, to involve an inventive step (to be non obvious), or to be industrially applicable have not been examined in respect of:

the entire international application.

claims Nos. 10-13, 15-41

because:

the said international application, or the said claims Nos. _____ relate to the following subject matter which does not require an international search (*specify*):

the description, claims or drawings (*indicate particular elements below*) or said claims Nos. 10-13, 15-41 are so unclear that no meaningful opinion could be formed (*specify*):

Claims 10-13 and 15-41 are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

the claims, or said claims Nos. _____ are so inadequately supported by the description that no meaningful opinion could be formed (*specify*):

no international search report has been established for said claims Nos. 10-13, 15-41

a meaningful opinion could not be formed without the sequence listing; the applicant did not, within the prescribed time limit:

furnish a sequence listing in the form of an Annex C/ST.25 text file, and such listing was not available to the International Searching Authority in the form and manner acceptable to it; or the sequence listing furnished did not comply with the standard provided for in Annex C of the Administrative Instructions.

furnish a sequence listing on paper or in the form of an image file complying with the standard provided for in Annex C of the Administrative Instructions, and such listing was not available to the International Searching Authority in the form and manner acceptable to it; or the sequence listing furnished did not comply with the standard provided for in Annex C of the Administrative Instructions.

pay the required late furnishing fee for the furnishing of a sequence listing in response to an invitation under Rule 13^{ter}.1(a) or (b).

See Supplemental Box for further details.

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Box No. V	Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement			
1.	Statement			
	Novelty (N)	Claims	1-9, 14	YES
		Claims	None	NO
	Inventive step (IS)	Claims	1-9, 14	YES
		Claims	None	NO
	Industrial applicability (IA)	Claims	1-9, 14	YES
		Claims	None	NO
<p>2. Citations and explanations:</p> <p>Claims 1-9 and 14 meet the criteria for PCT Article 33(2)-(3) because the prior art does not teach nor does it fairly suggest the claimed limitations.</p> <p>The prior art is exemplified by US 2012/0232264 A1 to Sato et al. (hereinafter Sato), JP 10-327900 A2 to Industrial Science and Technology Agency (hereinafter ISTA), and US 2014/0288298 A1 to Oji Holdings Corporation (hereinafter Oji).</p> <p>Regarding claim 1, Sato discloses of a method (para [0020]: "A first aspect of the biomass treatment method...") comprising: (a) hydrolyzing a hydrolysis composition with water, wherein the hydrolysis composition comprises biomass, to hydrolyze at least a portion of the biomass to form a first oligosaccharide product (para [0020]: "...in which pressurized hot water is used, biomass is hydrolyzed under first reaction conditions that provide... a first polysaccharide solution including xylooligosaccharides..."; see fig. 1), (b) hydrolyzing a hydrolysis composition with water, wherein the hydrolysis composition comprises biomass, to hydrolyze at least a portion of the biomass to form a second oligosaccharide product (para [0020]: "...and then the biomass is hydrolyzed under second reaction conditions that provide... a second polysaccharide solution including celooligosaccharides..."; see fig. 1), (c) hydrolyzing the first oligosaccharide via a catalyst to form a first monosaccharide (para [0020]: "...a first catalyst reaction process in which the first polysaccharide solution... is hydrolyzed using a solid acid catalyst so as to generate a first monosaccharide solution including xylose..."; see fig. 1), (d) hydrolyzing the second oligosaccharide via a catalyst to form a second monosaccharide (para [0020]: "...and a second catalyst reaction process in which the second polysaccharide solution... is hydrolyzed using a solid acid catalyst so as to generate a second monosaccharide solution including glucose"; see fig. 1). However, Sato does not disclose that the method comprises: (a) providing a hydrolysis composition of at least 20 wt% of sugar equivalents, wherein the hydrolysis composition comprises a first oligosaccharide, water, optionally a soluble aromatic compound, and optionally organic and/or inorganic impurities, (b) contacting the hydrolysis composition with a catalyst in a first reactor to hydrolyze at least a portion of the first oligosaccharide to form a first product composition comprising a first monosaccharide and a second oligosaccharide, (c) separating the first monosaccharide from the first product composition to form a second product composition comprising the second oligosaccharide, wherein at least a portion of the second oligosaccharide is a reversion sugar, and (d) converting via a further hydrolysis step at least a portion of the second oligosaccharide to form a third product composition comprising a second monosaccharide.</p> <p>ISTA discloses of a method (para [0009]: "Under these circumstances, the present invention is directed to a method for rapidly and efficiently producing a water-soluble oligosaccharide... [a]nd a method for producing monosaccharides...") comprising: (a) hydrolyzing a hydrolysis composition with water, wherein the hydrolysis composition comprises cellulose, to hydrolyze at least a portion of the biomass to form an oligosaccharide (para [0011]: "...the present invention relates to a method for producing water-soluble oligosaccharides, characterized in that cellulose powder is brought into contact with pressurized hot water heated at 200 to 300 degrees C. to hydrolyze..."), (b) hydrolyzing the oligosaccharide via a catalyst to form a monosaccharide (para [0018]: "Next, a method for producing a monosaccharide... an enzyme is allowed to act on a hydrolysis product mainly composed of a water-soluble oligosaccharide obtained by a hydrolysis treatment of cellulose and further hydrolysis is performed to produce a monosaccharide"; see instant specification [0052]: "Suitable catalysts include... enzymes"). However, ISTA does not disclose that the method comprises: (a) providing a hydrolysis composition of at least 20 wt% of sugar equivalents, wherein the hydrolysis composition comprises a first oligosaccharide, water, optionally a soluble aromatic compound, and optionally organic and/or inorganic impurities, (b) contacting the hydrolysis composition with a catalyst in a first reactor to hydrolyze at least a portion of the first oligosaccharide to form a first product composition comprising a first monosaccharide and a second oligosaccharide, (c) separating the first monosaccharide from the first product composition to form a second product composition comprising the second oligosaccharide, wherein at least a portion of the second oligosaccharide is a reversion sugar, and (d) converting via a further hydrolysis step at least a portion of the second oligosaccharide to form a third product composition comprising a second monosaccharide.</p> <p style="margin-top: 20px;">---Continued In Supplemental Box---</p>				

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Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of:
Box V.2 Citations and Explanations

Oji discloses of a method (para [0001]: "The present invention relates to a method for efficiently manufacturing monosaccharides, oligosaccharides, and/or furfurals...") comprising: (a) providing a hydrolysis composition comprising biomass and water (para [0319]: "An aqueous suspension raw material (raw material suspension) containing the raw material biomass was prepared..."), (b) performing a primary hydrolysis step, comprising hydrolyzing the hydrolysis composition to form oligosaccharides and monosaccharides (para [0001]: "The present invention relates to a method for efficiently manufacturing monosaccharides, oligosaccharides, and/or furfurals by performing continuous primary hydrolysis on a biomass..."; para [0320]: "The raw material suspension was... hydrolyzed in the continuous primary hydrolysis device R1 at 170 degrees C and 0.79 MPa..."; see table 9, Production Example 40 (Primary hydrolysis solution), yield comprises monosaccharides and oligosaccharides), (c) performing a secondary hydrolysis step, comprising hydrolyzing the discharge of the oligosaccharides and monosaccharides from the primary hydrolysis step, to form additional oligosaccharides and monosaccharides (para [0001]: "The present invention relates to a method for efficiently manufacturing monosaccharides, oligosaccharides, and/or furfurals by performing continuous primary hydrolysis on a biomass and performing secondary hydrolysis on the primary hydrolysis solution obtained by continuous primary hydrolysis"; para [0321]: "Next, the primary hydrolysis solution of Production Example 40 was transferred to the secondary hydrolysis device R2 (T1,T2)... [h]ydrolysis was performed..."; see table 9, Production Examples 42 through 47, all secondary hydrolysis products contain oligosaccharides and monosaccharides). However, Oji does not disclose that the method comprises: (a) providing a hydrolysis composition of at least 20 wt% of sugar equivalents, wherein the hydrolysis composition comprises a first oligosaccharide, water, optionally a soluble aromatic compound, and optionally organic and/or inorganic impurities, (b) contacting the hydrolysis composition with a catalyst in a first reactor to hydrolyze at least a portion of the first oligosaccharide to form a first product composition comprising a first monosaccharide and a second oligosaccharide, (c) separating the first monosaccharide from the first product composition to form a second product composition comprising the second oligosaccharide, wherein at least a portion of the second oligosaccharide is a reversion sugar, and (d) converting via a further hydrolysis step at least a portion of the second oligosaccharide to form a third product composition comprising a second monosaccharide.

There is no prior art that discloses the claimed subject matter, specifically a method comprising (a) providing a hydrolysis composition of at least 20 wt% of sugar equivalents, wherein the hydrolysis composition comprises a first oligosaccharide, water, optionally a soluble aromatic compound, and optionally organic and/or inorganic impurities, (b) contacting the hydrolysis composition with a catalyst in a first reactor to hydrolyze at least a portion of the first oligosaccharide to form a first product composition comprising a first monosaccharide and a second oligosaccharide, (c) separating the first monosaccharide from the first product composition to form a second product composition comprising the second oligosaccharide, wherein at least a portion of the second oligosaccharide is a reversion sugar, and (d) converting via a further hydrolysis step at least a portion of the second oligosaccharide to form a third product composition comprising a second monosaccharide. It would have been obvious to one of ordinary skill in the art to form a monosaccharide from an oligosaccharide by hydrolysis using a catalyst, based on the teachings of Sato and ISTA, since both disclose of forming monosaccharides via catalyst/enzyme hydrolyzation of an oligosaccharide, as discussed above. It would also have been obvious to one of ordinary skill in the art to form two monosaccharide products from an oligosaccharide via hydrolysis, based on the teachings of Sato. However, Sato does not disclose of forming the first and second monosaccharides in a sequential two-step hydrolysis method, as required in steps (b) through (d). Sato instead discloses of a method of forming the two monosaccharide products in two distinct processes from two different oligosaccharides, the processes performed simultaneously (see fig. 1). Oji discloses that, in the second hydrolysis process, second oligosaccharides are formed from a solution containing first oligosaccharides and first monosaccharides, as discussed above, however, Oji does not disclose that at least a portion of the second oligosaccharide is a reversion sugar. Further, neither Sato nor ISTA disclose of an oligosaccharide wherein at least a portion of the second oligosaccharide is a reversion sugar. Further, neither Sato, ISTA, nor Oji disclose of separating a first monosaccharide and a second oligosaccharide. Additionally, neither Sato, ISTA, nor Oji disclose that the starting material, the hydrolysis composition, comprises: a first oligosaccharide, water, optionally a soluble aromatic compound, and optionally organic and/or inorganic impurities, having at least 20 wt% of sugar equivalents. It would not have been obvious to one of ordinary skill in the art to form a method comprising (a) providing a hydrolysis composition of at least 20 wt% of sugar equivalents, wherein the hydrolysis composition comprises a first oligosaccharide, water, optionally a soluble aromatic compound, and optionally organic and/or inorganic impurities, (b) contacting the hydrolysis composition with a catalyst in a first reactor to hydrolyze at least a portion of the first oligosaccharide to form a first product composition comprising a first monosaccharide and a second oligosaccharide, (c) separating the first monosaccharide from the first product composition to form a second product composition comprising the second oligosaccharide, wherein at least a portion of the second oligosaccharide is a reversion sugar, and (d) converting via a further hydrolysis step at least a portion of the second oligosaccharide to form a third product composition comprising a second monosaccharide, since the prior art that discloses of forming monosaccharide products via hydrolysis of an oligosaccharide do not do so in a two-step sequential method, further comprising a separating step, wherein one of the products is a reversion sugar, or that the hydrolysis composition specifically comprises 20 wt% of sugar equivalents. Thus, claim 1 meets the criteria set out in PCT Article 33(2)-(3).

Claims 2-9 and 14 meet the criteria for PCT Article 33(2)-(3) because they depend on claim 1 either directly or indirectly.

Claims 1-9 and 14 have industrial applicability as defined by PCT Article 33(4) because the subject matter can be made or used in industry.