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Datasheet for the decision of 15 March 2019

Case Number: T 2055/15 - 3.3.06

Application Number: 09714368.9

Publication Number: 2247781

IPC: D21C1/02, D21C3/22, D21C3/26, D21C7/00, D21B1/36

Language of the proceedings: EN

Title of invention:

SYSTEM AND METHOD FOR PREEXTRACTION OF HEMICELLULOSE THROUGH USING A CONTINUOUS PREHYDROLYSIS AND STEAM EXPLOSION PRETREATMENT PROCESS

Patent Proprietor:

Andritz, Inc.

Opponents:

Biochemtex S.p.A.
SEKAB E-Technology AB

Headword:

SYSTEM FOR PRETREATING CELLULOSIC BIOMASS FEEDSTOCK / ANDRITZ

Relevant legal provisions:

EPC Art. 56
RPBA Art. 12(4), 13(1)

Keyword:
Inventive step - (yes)

Decisions cited:

Catchword:

Europäisches Patentamt
European Patent Office
Office européen des brevets

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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 2055/15 - 3.3.06

D E C I S I O N
of Technical Board of Appeal 3.3.06
of 15 March 2019

Appellant III: (Patent Proprietor)	Andritz, Inc. One Namic Place Glens Falls, NY 12801 (US)
Representative:	Hoffmann Eitle Patent- und Rechtsanwälte PartmbB Arabellastraße 30 81925 München (DE)
Appellant I: (Opponent 1)	Biochemtex S.p.A. Strada Ribrocca 11 15057 Tortona (AL) (IT)
Representative:	Uexküll & Stolberg Partnerschaft von Patent- und Rechtsanwälten mbB Beselerstraße 4 22607 Hamburg (DE)
Appellant II: (Opponent 2)	SEKAB E-Technology AB Box 286 891 26 Örnsköldsvik (SE)
Representative:	Zumstein, Angela Maiwald Patentanwalts- und Rechtsanwaltsgesellschaft mbH Elisenhof Elisenstraße 3 80335 München (DE)
Decision under appeal:	**Interlocutory decision of the Opposition Division of the European Patent Office posted on 3 September 2015 maintaining European Patent No. 2247781 in amended form.**

Composition of the Board:

Chairman	J.-M. Schwaller
Members:	P. Ammendola
	J. Hoppe

Summary of Facts and Submissions

I. The appeals by the patent proprietor and both opponents are from the interlocutory decision of the opposition division maintaining European patent No. 2 247 781 in amended form on the basis of the claims according to the Auxiliary Request 10 dated 19 June 2015.

II. With their respective statement of grounds of appeal opponents 1 and 2 referred inter alia to documents:

NPL1: A. Wingren *et al.*, "*Process Considerations and Economic Evaluation of Two-Step Steam Pretreatment for Production of Fuel Ethanol from Softwood*", Biotechnol. Prog., 2004, Vol.20, No.5, pages 1421-1429

D6: US 4,427,452

and filed new documents, including:

D9: *Handbook on Ethanol: Production and Utilization*, C.E. Wyman Ed., London 1996, pages 179-211.

D11: *Handbook for Pulp & Paper Technologists*, G.S. Smook Ed., 3rd Ed., Vancouver 2002, pages 90-98.

Opponent 1 also raised new objections of lack of clarity against the maintained claims.

III. The proprietor's reply of 6 June 2016 was enclosed with new sets of claims, one of which was labelled Auxiliary Request 10a.

IV. Opponent 1 provided further comments in a letter enclosed with, *inter alia*, a new document that the board has numbered

D16: M.H. Thomsen *et al.*, "*Hydrothermal treatment of wheat and straw at pilot plant scale using a three-step reactor system aiming at high hemicelluloses recovery, high cellulose digestibility and low lignin hydrolysis*", Bioresource Technology, Vol. 99 (2008), pages 4221-4228, available online 23 October 2007.

V. The board expressed its preliminary opinion on the admissibility into the appeal proceedings of the new requests and documents.

VI. At the oral proceedings of 15 March 2008, in which only the proprietor was represented, this latter withdrew all its previously pending requests excepted Auxiliary Request 10a which became the new Main Request (herein after **Main Request**). The parties' final requests were established to be as follows:

Opponents 1 and 2 requested in writing that the decision be set aside and the patent be revoked.

The proprietor requested that the decision be set aside and that the patent be maintained on the basis of the claims of the Main Request (formerly Auxiliary Request 10a of 6 June 2016).

VII. The Main Request comprises eight claims of which independent claims 1 and 6 read as follows:

"*1. A system for pretreating cellulosic biomass feed stock (14) comprising:*

a first pressurized reactor (12) receiving the feed stock (14), wherein the feed stock (14) undergoes hydrolysis in the first pressurized reactor (12) at a gauge pressure in a range of 1.5 bar gauge to 6 bar gauge, and at a temperature of at least 110 degrees Celsius;

a sealing and extraction device (18) having a first pressurized coupling to a feedstock discharge port of the first pressurized reactor (12) and a second pressurized coupling to a second pressurized reactor of a second pressurized reactor assembly;

a wash stage (15) introducing a wash liquid into the feed stock (14) in the first pressurized reactor (12);

a drain for removing a liquid including dissolved hemi-cellulosic material extracted from the feed stock (14) in at least one of the first pressurized reactor (12) and the sealing and extraction device;

the second pressurized reactor assembly receiving the pressurized feed stock (14) from the sealing and extraction device and infusing a steam or water vapor into the feed stock (14) in the second pressurized reactor assembly, wherein the reactor assembly applies a gauge pressure to the feed stock (14) in a range of 8 bar gauge to 25.5 bar gauge, and the second pressurized reactor assembly having a pressurized discharge coupled to a discharge conduit, and

an expansion device downstream of the second pressurized reactor assembly, wherein the expansion device rapidly releases the pressure of the feed stock (14) discharged from the second pressurized reactor assembly such that the feed stock (14) undergoes a steam explosion reaction."

"*6. A method for pretreating cellulosic biomass feed stock (14) comprising:*

pretreating the feed stock (14) in a first pressurized reactor (12), wherein the feed stock (14) undergoes hydrolysis in the first pressurized reactor (12);

discharging the feed stock (14) from the first pressurized reactor (12) to a pressurized sealing device (18) having a first pressurized coupling to a feedstock discharge port of the first pressurized reactor (12);

maintaining a vapor phase in the first pressurized reactor (12) by injecting steam into the first pressurized reactor (12), wherein the injected steam provides heat energy to the feed stock in the first pressurized reactor (12);

washing the feed stock (14) in a downstream region of the first pressurized reactor (12);

draining a liquid including dissolved hemi-cellulosic material extracted from the feed stock (14) from at least one of the first pressurized reactor (12) and the pressurized sealing device (18);

discharging the feed stock (14) from the pressurized sealing device (18) through a second pressurized coupling to a second pressurized reactor (16), wherein the feed stock (14) is maintained at a higher pressure in the second pressurized reactor (16) than in the first pressurized reactor (12);

in the second pressurized reactor (16), infusing cells of the feed stock (14) with steam or water vapor by injecting steam or water vapor into the second pressurized reactor (16), and

rapidly releasing a pressure applied to the feed stock (14) infused with water to cause steam expansion in the cells of the feed stock (14) and refine the feed stock (14)."

Dependent claims 2 to 5 define preferred embodiments of the system of claim 1 and dependent claims 7 and 8 of the method of claim 6.

VIII. The proprietor disputed, *inter alia*, the admissibility of documents D9, D11 and D16.

Opponent 1 disputed the admissibility of auxiliary request 10a (now Main Request) and objected to its claimed subject-matter under inventive step.

No submissions have been filed by opponent 2 in respect of Auxiliary Request 10a.

Reasons for the Decision

1. Admittance of the Main Request

1.1 Opponent 1 (see the entire section "I.2", from page 3 to page 7, of its letter dated 12 January "2016" (sic)) requested the board not to admit into the appeal proceedings any of the auxiliary requests filed by the proprietor on 6 June 2016 because of the number of auxiliary requests already on file, as well as because these auxiliary requests were non-converging and *prima facie* not clearly allowable.

1.2 The board notes however that this request had been filed with the proprietor's reply (of 6 June 2016) to the opponent's grounds of appeal and thus, in accordance with Article 12(1) RPBA.

Furthemore new objections under Article 84 EPC have been raised against claim 1 as maintained with the grounds of appeal of opponent 1, and the Main Request results from a very limited modification of the

maintained claims, modification manifestly apt at overcoming such new objections. Consequently the opponent did not pursue the clarity objection as regards this request.

1.3 In view of the above the board using its discretion saw no reason not to admit this request into the appeal proceedings under the provisions of Article 12(4) RPBA.

2. Admittance of documents D9, D11 and D16

2.1 For the board, D9 and D11 have not been filed unjustifiably late since they were filed with opponent 1's grounds of appeal and thus, in accordance with Article 12(1) RPBA. Furthermore as indicated in the board's preliminary opinion, and undisputed by the proprietor, D9 and D11 are evidence of common general knowledge. The board therefore saw no reason not to admit these documents into the appeal proceedings.

2.2 D16 has been filed with a letter dated 12 January 2016 (sic: should have read "2017") to further support the objection of lack of inventive step against, *inter alia*, claims 1 and 6 of the Main Request, purportedly in consequence of an additional search that was alleged to have become necessary in view of the "constant filing" of new requests.

For the board, as convincingly argued by the proprietor, the disclosure of D16 is *prima facie* not more relevant than that available in the documents considered in the opposition proceedings. Therefore, the board exercised its discretion under the provisions of Article 13(1) RPBA and decided not to admit D16 into the appeal proceedings.

3. Main request - Inventive step (Article 56 EPC)

3.1 Closest prior art

3.1.1 The subject-matter of claim 1 at issue relates to a system, i.e. an apparatus as confirmed by the proprietor, suitable for "*pretreating cellulosic biomass feed stock*". Such pretreatment is the initial stage of the conventional process for generating a pretreated cellulosic feed stock that can then be enzymatically converted into e.g. bioethanol (see [0001] and [0002] of the patent in suit).

3.1.2 Opponent 1 (see its letter of 12 January "2016", section 1.2 starting in page 16 and section 1.5 starting in page 22) considered each of D6 and NPL1 to disclose prior art suitable as starting point for the assessment of inventive step of this claim.

3.1.3 The board notes that document D6 does not mention the "pretreatment" of cellulosic materials and, as explained hereinafter, at least two features of claim 1 at issue are absent in the apparatuses depicted in Figure 1 and described from column 7, line 42 to column 10, line 11 of D6.

In D6 a blow tank ("16" in Figure 1) is mandatorily interposed between the two pressurised reactors (the "tube digesters" "11" and "23" of Figure 1). On the contrary, in claim 1 at stake the two pressurised reactors are mandatorily connected via pressurised couplings through the sealing and extraction device and, thus, the claimed system undisputedly encompasses no such blow tank between the two pressurised reactors.

The second feature of the system of claim 1 at issue that is absent in the apparatus of D6 is a "*wash stage*" in which the wash liquid is introduced into the feed stock in the first pressurized reactor.

3.1.4 Opponent 1's submissions (section bridging pages 19 and 20 of its grounds of appeal) are found unconvincing for the following reasons:

- In its view a wash stage existed in the apparatus of D6, due to the means that allow counter current flow of hydrolysate (e.g. collected from "worm separators" "18" and "19" located after the blow tank "16") via the pipe "14" to the outlet of the first pressurised reactor (the digester "11"). Opponent 1 stressed in particular that the liquid flown back to the first reactor would explicitly be described on column 9, lines 3 to 4, of D6 as "wash hydrolysate" (emphasis added by the board).

- For the board, this last expression as used in the context of D6 (see also in column 8, lines 60 to 64, the mention of "the counter current wash principle" and in column 9, line 33 to 41, the different stages of Figure 1 in which "wash water" and "wash hydrolysate" are introduced/circulated) confirms that the liquid counter circulated in the first reactor is exclusively a "hydrolysate", i.e. the aqueous liquor containing the soluble compounds formed during the hydrolysis of the cellulosic material (in any of the the two digesters).

- On the contrary, the board finds convincing the argument of the proprietor that a skilled person would normally consider an apparatus suitable for "washing", in particular in the case that the

material to be "washed" is a solid that has been partially dissolved into an (aqueous) solvent, as a device having means for contacting the residual solid (i.e. the solid remaining after that the partial dissolution has already occurred) with fresh (aqueous) solvent, i.e. solvent that does not contain the same soluble products that have been dissolved into the aqueous solvent during the preceding treatment of the solid and that any "washing" step normally aims at removing from the residual solid. The board sees no teaching in the patent in suit justifying a different construction of the "*wash stage*" of the claimed system. In particular, also Figures 1 to 8 of the patent and the description relating thereto (see in particular paragraphs [0023] and [0027]) associate the "*wash stage*" and "*washing apparatus*" exclusively to the introduction of "*dilution water*", "*clean water*", "*wash water*", "*acid solutions*", "*water steam*" (presumably condensed) and "*combinations*" of these two latter. Hence, a skilled reader of claim 1 at issue in the context of the whole patent disclosure would also consider implied by the definition of the "*wash stage*" in such claim that the "*wash liquid*" that is introduced into the feed stock in the first pressurised reactor must in particular be free of the soluble products that are formed by hydrolysis of the feed stock.

Hence, the means enabling counter current flow of hydrolysate in the first digester of the apparatus of D6 cannot be considered to be means apt at introducing a conventional "*wash liquid*" into the feed stock and, thus, also to be part of a "*wash stage*" in the first pressurised reactor in the sense of claim 1 at issue.

3.1.5 Instead it is common grounds among the parties that NPL1 discloses a system for pretreating lignocellulosic materials (i.e. a system for the same initial stage of the production of bioethanol) extremely similar to that defined in claim 1 at issue. Indeed, the requirement of the system of claim 1 at issue that the "*wash stage*" must enable the introduction of "*a wash liquid into the feed stock in the first pressurized reactor*" (emphasis added) represents the only feature distinguishing this latter from the variant of the apparatus depicted in Figure 2 of NPL1 in which the stock feed is (not flashed but dewatered and) washed under pressure e.g. in the filter between arrows 5 and 6 in the right portion of Figure 2, i.e. is only washed after the first pretreatment reactor (see also the sentence bridging the two columns in page 1422; the last paragraph in the right column of page 1422, and the exemplified method described in the section starting with "(c) No Flashing after the First Step" in the right column of page 1426). The board comes therefore to the conclusion that NPL1 represents the closest prior art.

3.2 The technical problem solved according to opponent 1

3.2.1 For opponent 1 (see section 1.2, page 16 to 18 of its letter of 12 January "2016", second paragraph on page 17 in combination with the last two paragraphs of that section in page 18), the sole technical problem solved is the provision of an alternative to the closest prior art, i.e. the provision of a further apparatus for the pretreatment of cellulosic feed stock for the production of bioethanol.

3.2.2 In the proprietor's view the technical problem solved would instead be the provision of a pretreatment system more economical than that of NPL1.

3.2.3 For the board it is immediately apparent that even in the hypothetical case that the subject-matter of claim 1 at stake only solved the less ambitious technical problem of just providing an alternative to the prior art of departure, still the cited prior art could not have rendered obvious the solution thereto proposed in claim 1 at issue.

3.2.4 Hence, the reasoning on the presence of an inventive step given below is based on the assumption, in favour of the opponents, that the technical problem solved is that of providing an alternative to the apparatus for pretreating cellulosic feed stock disclosed in (the above identified passages of) NPL1.

3.3 Non-obviousness of the claimed subject-matter

3.3.1 In view of the above technical problem the assessment of inventive step boils down to the question whether a skilled person searching for an alternative to the relevant pretreatment apparatus disclosed in NPL1 would have considered obvious to modify the design of this prior art system (that only discloses washing the solid after the first pressurised reactor) by (re-)locating the washing step into the first pressurised reactor instead.

3.3.2 The board notes that no teaching suggesting such modification is explicitly or implicitly contained in NPL1.

3.3.3 Opponent 1 (see section 1.3 starting in page 18 of its letter of 12 January "2016") argued that the common general knowledge proved by D9 and D11 rendered apparent the use of e.g. the most widely used digester for paper pulping (i.e. the "Kamyr" vertical digester of Figure 8-12 of D11) also as first reactor in the pretreatment system of NPL1. Since such digester also comprised a "wash stage" in the sense of claim 1 at issue, the combination of NPL1 with the common general knowledge reported in D9 and D11 rendered obvious the subject-matter of said claim 1.

3.3.4 For the board, document D9 proves the existence of several alternatives for the pretreatment of cellulosic feed stock (in the process for obtaining bioethanol) and, thus, also of several alternative designs for carrying out such pretreatment. In particular, it is apparent that the common general knowledge (on, *inter alia*, the combined application of diluted acid / acid impregnated steam and steam explosion) summarised in the upper half of page 185 of D9 relates to the same kind of pretreatment process used in NPL1. The board notes however that in such portion of page 185 of D9 there is no explicit mention of pulping apparatuses or digesters nor of paper pulping or digesting steps.

3.3.5 Opponent 1 also referred to the second paragraph of page 192 of D9 which discloses among other reactor configurations:

- one "continuous horizontal pulping digester" (emphasis added by the board) that has been included "[i]n a preliminary dilute sulfuric acid pretreatment system design";

- one "pilot scale, continuous, vertical pretreatment reactor, similar to a continuous pulping digester" (emphasis added by the board) that has been used "to develop and demonstrate dilute-acid pretreatment" and

- one (not further specified) reactor similar to this latter that has been installed in a process development unit.

3.3.6 The board finds such disclosure too limited and too vague to demonstrate that a skilled person would in general consider any continuous paper pulping apparatus also suitable for carrying out the pretreatment of cellulosic material with diluted acid or acid impregnated steam. The same limited and vague disclosure also lacks of any clear teaching pointing specifically to the "Kamyr" digester (which actually is a continuous vertical digester).

Hence, although the "Kamyr" apparatus is the digester most widely utilised for paper pulping, still the common general knowledge resumed in D9 does not demonstrate that a skilled person would normally expect that such paper pulping digester could be used for carrying out the first pretreatment step of NPL1.

The board therefore finds that the combination of NPL1 with the common general knowledge proved by D9 and D11 cannot render obvious the modification of the prior art required to arrive at the subject-matter of claim 1 under consideration.

3.3.7 As to opponent 1's argument that D6 would also render obvious the claimed system, the board is convinced that a skilled person cannot find in D6 any teaching

relating to a wash stage introducing the wash liquid into the feed stock in the first pressurised reactor. Indeed, as already discussed above, D6 only discloses the counter current flow of hydrolysate in the first digester. Hence, also this prior art cannot motivate the skilled person to modify the design of the apparatus disclosed in NPL1 so as to introduce "*wash liquid*" into the feed stock - and, thus, to wash this latter - (already) in the first pressurised reactor.

3.4 Hence, the board concludes that the common general knowledge and the prior art referred to do not render obvious the modification of the closest prior art required to arrive at the system of claim 1 at issue. Thus, the subject-matter of such claim (and of claims 2 to 5 which depends thereon) is found to comply with the requirements of Article 56 EPC.

3.4.1 It is indeed self-evident that claim 6 defines a method for pretreating cellulosic biomass feed stock encompassing the same steps that are enabled by the specific design of the system of claim 1. In particular, also claim 6 requires the occurrence of (a) "*washing*" (step) in the first pressurised reactor, a step which manifestly corresponds to the requirement of the system of claim 1 of "*a wash stage introducing a wash liquid into the feed stock in the first pressurized reactor*".

3.4.2 Accordingly, the board finds for substantially the same reasons given above, that:

- the prior art closest to the subject-matter of claim 6 is the pretreatment method with a pressurised washing step after the first pretreatment reactor that is disclosed by NPL1, and

- even assuming, in favour of the opponents, that the subject-matter of claim 6 represents just an alternative to the pretreatment method of NPL1, the common general knowledge proved by D9 and D11 and the prior art disclosed in D6 are insufficient at proving obvious to (re-)locate the washing step (only taking place after the first pressurized reactor in the pretreatment of NPL1) into the first pressurised reactor instead.

3.4.3 Since the common general knowledge and prior art referred to do not render obvious the modification of the closest prior art required to arrive at the method of claim 6 of the Main Request, the subject-matter of such claim (and that of claims 7 and 8 which depend thereon) is found to comply with the requirements of Article 56 EPC.

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 maintain the patent in amended form on the basis of claims 1 to 8 of the Main Request, formerly Auxiliary Request 10a of 6 June 2016, and a description to be adapted thereto.

The Registrar: The Chairman:

D. Magliano J.-M. Schwaller

Decision electronically authenticated