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**Datasheet for the decision  
of 4 December 2013**

**Case Number:** T 0357/11 - 3.3.06

**Application Number:** 99935224.8

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**IPC:** D21C3/02, D21C3/24

**Language of the proceedings:** EN

**Title of invention:**

METHOD FOR PRECIPITATING HEMICELLULOSE ONTO FIBRES FOR  
IMPROVED YIELD AND BEATABILITY

**Patent Proprietor:**

Metso Paper Sweden AB

**Opponent:**

Andritz Inc.

**Headword:**

Hemicellulose precipitation/ Metso Paper

**Relevant legal provisions:**

EPC Art. 52(1), 56

**Keyword:**

Inventive step - (yes) non-obvious method

**Decisions cited:**

T 1188/00

**Catchword:**



**Beschwerdekammern**  
**Boards of Appeal**  
**Chambres de recours**

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Case Number: T 0357/11 - 3.3.06

**D E C I S I O N**  
**of Technical Board of Appeal 3.3.06**  
**of 4 December 2013**

**Appellant:** Andritz Inc.  
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**Decision under appeal:** **Decision of the Opposition Division of the European Patent Office posted on 3 December 2010 rejecting the opposition filed against European patent No. 1115943 pursuant to Article 101(2) EPC.**

**Composition of the Board:**

**Chairman:** B. Czech  
**Members:** G. Santavicca  
U. Lokys

## Summary of Facts and Submissions

I. The appeal lies from the decision of the opposition division rejecting the opposition against European patent n° 1 115 943.

II. Claim 1 as granted reads as follows:

*"1. A method for continuous cooking of lignocellulosic fibre material, comprising the steps of sequentially*  
*(a) in a first stage, impregnating the fibre material in an impregnation liquid comprising alkali metal hydroxide, and thereafter withdrawing (14, 514) a spent impregnation liquid,*  
*(b) in a second stage, cooking the fibre material in a cooking liquor comprising alkali metal hydroxide,*  
*(c) in a third stage, adding (A), to said fibre material, a liquid which is rich in hemicellulose, said liquid preferably comprising at least a part (14a, 514a) of said withdrawn spent impregnation liquid, characterised by*  
*(d) in a fourth stage, cooking the fibre material in a cooking liquor comprising the liquid added in the third stage, whereby the fibre material is subjected to a retention time of at least 1 hour in said fourth stage."*

Dependent claims 2 to 13 of the patent as granted are directed to preferred embodiments of the process according to granted claim 1.

III. The patent had been opposed in its entirety on the ground of lack of an inventive step (Article 100(a) EPC). The evidence relied upon in the opposition proceedings includes the following documents:

D1: US 3,354,029 A;

D2: US 3,937,647 A;

Declaration by Mr Lindström (dated 24 January 2001;  
filed with letter of 29 November 2002)

IV. In the decision under appeal, it was inter alia held  
that:

- a) The closest prior art was described by D1, which, as the patent in suit, was concerned with increasing the yield of pulp by (re)adsorption of hemicelluloses on the fibre material during the final stage of the cooking process.
- b) The claimed method differed from the method of D1 in that, in the fourth stage, i.e. after addition of the hemicellulose-rich liquid to the cook, a retention time of at least one hour was required, compared to a retention time of 20 minutes as illustrated by Example 5 of D1.
- c) The problem to be solved was to improve the yield.
- d) The skilled person starting from D1, whose main object was to increase the yield whilst preventing precipitation of lignin, by adjustment of the pH, would not have considered D2, which taught how to increase the yield by precipitation of lignin at a pH lower than that used in the process of D1.
- e) Even if the skilled person were to consider D2, he would not have ended up to the claimed subject-matter, as D1 taught away from longer cooking times and D2 did not hint at increasing the yield

by only extending the cooking time, i.e. without lowering the pH.

f) Thus, the claimed subject-matter was not obvious.

V. In its statement setting out the grounds of appeal, the appellant (opponent) maintained the ground of lack of an inventive step having regard to documents D1 and D2.

VI. In its response, the respondent (patent proprietor) maintained that D1 was the closest prior art document for assessing inventive step, that the skilled person would not have combined the teaching of D1 with that of D2, but that even when considering together both D1 and D2, the claimed subject-matter was not obvious.

VII. In response to a communication by the Board in preparation for oral proceedings:

a) The respondent (letter of 22 October 2013) submitted amended sets of claims as auxiliary requests 1 to 6. Then, with letter of 4 November 2013, the respondent withdrew auxiliary requests 3 and 4 on file, re-filed auxiliary requests 1 and 2 and submitted new auxiliary requests 3 to 7.

b) The appellant, in its replies, maintained the inventive step objection based on documents D1 and D2 in respect of the respondent's main request and raised various objections against all the auxiliary requests submitted by the respondent.

VIII. At the oral proceedings held before the Board on 4 December 2013, the debate focussed on the issue of inventive step with regard to the subject-matter of granted Claim 1, in the light of D1 (in particular

Example 5) taken as the closest prior art and document D2, taking also into account the Lindström declaration.

- IX. The appellant (opponent) requested that the decision under appeal be set aside and the European patent be revoked.
- X. The respondent (patent proprietor) requested that the appeal be dismissed (main request) or, alternatively, that the patent be maintained on the basis of one of the auxiliary requests 1 to 7 submitted with the letter dated 4 November 2013.
- XI. The arguments of the appellant regarding the respondent's main request can be summarised as follows:

*Closest prior art*

- a) The closest prior art was disclosed by D1 (Figure and relevant description, Example 5), which concerned a process for continuous cooking of lignocellulosic material comprising the steps of:
- impregnation with cooking liquor comprising alkali metal hydroxide (in this respect, it was argued that Claim 1 did not specify the kind of impregnation step), carried out in a heating zone;
  - liquor withdrawal from the end of heating stage/beginning of digesting zone, which was thus rich in hemicelluloses;
  - digesting (second stage);
  - addition of the previously withdrawn liquor rich in hemicelluloses to a sorption zone (third stage);
  - in that sorption zone, carrying out further cooking in a cooking liquor comprising the liquor transferred (fourth stage).

- b) D1 did not generally disclose a retention time for the sorption zone, but illustrated in its Example 5 a retention time of 20 minutes. Thus, a retention time of at least one hour was the only distinctive feature of the claimed process over D1.

*Problem solved*

- c) According to the patent in suit, a longer retention time provided good yield and beatability. However, it had not been demonstrated that a retention time of 1 hour, compared to 20 minutes in D1, increased the yield or beatability. The examples illustrated in the patent in suit provided the results shown in Figure 9, which were not comparative over D1, but over a process without liquor transfer and over some other kinds of liquor transfers. The kind of wood used was not specified, let alone the retention time, or the temperature, the pH, etc. An analysis of the results merely showed that the liquor transfer as such might or might not have an effect.
- d) The Lindström's declaration lacked many particulars and raised many questions. It was not apparent where the xylan rich liquor came from. The invoked statement in the patent in suit (paragraph [0003], "*softwood contain only about 10% xylan*") had to do with the xylan content in the softwood, not in a liquor. So, the liquor used was rather unusual. The operating conditions used, such as alkali level and pH were not given. The indication that a retention time of 50 to 60 minutes produced no effect was contrary to the teaching of D1. A comparison of the declaration's

results with the results shown in Figure 9 of the patent in suit (cooked softwood pulp) showed that the declaration claimed a much more pronounced improvement than the patent itself. Hence, this declaration was not convincing and, in any case, did not constitute a comparison over D1.

- e) Hence, there was no evidence on file showing that a prolonged retention time led to any better yield or beatability. The burden of proof lay on the respondent and had not been discharged. As Claim 1 did not specify either any upper retention time limit and as the criticality of the minimum retention time of 1 hour had not been proven, the lack of conclusive evidence was even more apparent. It was not clear whether the invoked effect persisted after e.g. 5 hours, and the Lindström declaration did not show what happened after two hours. Therefore, the technical problem was merely the provision of an alternative method for the continuous cooking of lignocellulosic material.

#### *Obviousness*

- f) D1 disclosed that several routine parameters influencing the cooking process such as pH value, temperature and retention time could be changed. "Several" did not mean "so many" parameters, as argued by the respondent. D1 disclosed quite short retention times but did not generally exclude longer retention times. In fact, the degradation of hemicelluloses in the cooking liquor was prevented, in D1, by the proposed liquor transfer, as the patent in suit.



g) D2 concerned a process which was very similar to that of D1, namely promoting re-adsorption of organic substances onto the fibres, in particular hemicellulose and lignin. Since time influenced precipitation of both hemicellulose and lignin, and since the skilled person knew what further measure influenced the one or the other precipitation, the teachings of D1 and D2 were not incompatible. Both D1 and D2 disclosed that lowering the pH influenced the precipitation, the difference of lowering being minimal (11.5 in D1, beneath 11 in D2). In this respect, also paragraph [0037] of the patent in suit mentioned the possibility of acid addition to lower the pH. As the time increments underlying the changes of retention times in the examples of D2 were high, the skilled person would have changed substantially the retention time of the process of D1. A comparison of the examples of D2, in particular 6 and 7, showed that, among the several parameters which could be changed, retention time directly influenced the desired substantial re-adsorption of organic substances, also defined in Claim 1 of D2. Claim 4 of D2 required a time of up to 300 minutes, which according to Example 7 led to a better yield in comparison to the retention time of Example 6, i.e. 15 minutes, like D1. Furthermore, D2 generally stated that the longer the retention time the better the precipitation and re-adsorption of organic substances onto the fibres, which of course applied to hemicelluloses too. Since this statement was of general character, it was not linked to the reduction of pH also mentioned in D2. Hence, even if the Board were to acknowledge the improvement in yield shown in the Lindström declaration, this general

statement in D2 established nevertheless a clear connection between longer retention time and extent of precipitation of organic substances. As regards the kappa number, it had to be considered that Claim 1 of the patent in suit did not include any feature which influenced the kappa number, and that the skilled person knew ways of influencing the precipitation of lignin, thus the kappa number. Hence, D2 disclosed the most promising alternative to the process of D1. For the skilled person starting from D1 and aiming to provide an alternative continuous process of cooking lignocellulosic material it was thus obvious to arrive at a process with a retention time of at least one hour, as claimed, in view of the teaching of D2 and common general knowledge on continuous cooking of lignocellulosic material.

XII. The arguments of the respondent regarding its main request can be summarised as follows:

*Closest prior art*

- a) The present invention dealt with a continuous process for cooking lignocellulosic material which aimed at obtaining pulp of low kappa value (i.e. low lignin amount), at better yield and beatability. D1 described the closest prior art. However, whilst D1, and in particular example 5 thereof, illustrated only batch processes, the claimed process was continuous. Moreover, the latter also comprised a separate impregnation step, carried out at low temperature, not described as such in D1. The process of D1 instead comprised a heating zone, in which cooking, thus delignification, started immediately. The

indication, in D1, that the method disclosed was suitable for continuous processing did not amount to a disclosure of how to implement a continuous process on the basis of the teaching of D1. Hence, although the crucial distinction of the claimed method over D1 was the retention time of at least one hour in the fourth stage, there were in fact at least three distinctions over D1.

*Problem solved*

- b) The declaration by Mr Lindström evidenced the fact that xylan precipitation and adsorption required time, i.e. that long retention time was necessary to improve the yield. Thus, time dependency of re-adsorption/yield was the decisive teaching of that declaration. The declaration also explained the chemistry behind the retention time, which was shown for softwood but applied likewise to hardwood, and demonstrated why even an increase of 1% in yield was an important result. The doubts cast by the appellant on Lindström declaration were not convincing. The experiment was carried out in 2002 on Norwegian spruce chips. A 8% content of xylan was in line with the statement in the patent in suit concerning the xylan content of softwood (about 10%), hence no contradiction arose therefrom. A cook temperature of 162°C was not very different from that used in the last stage of Example 5 of D1 (160°C). The attainment of a plateau was clearly shown. No contradiction with Figure 9 of the patent in suit was apparent in this respect. Hence, the declaration proved that retention time was important for high yield to be attained.

- c) A comparison of the yields mentioned in Figure 9 of the patent in suit and in D1 was not possible, as different wood materials had been used (Example 5 of D1 did not specify the quality of the birch chips used and Figure 9 concerned softwood). Also, the disclosure of the retention time in Example 5 of D1, which was a laboratory batch process, was an accidental disclosure, which did not amount to an actual way of implementation in a continuous process. As regards the alleged lack of any upper limit for the retention time in Claim 1, an upper limit was immediately apparent for the skilled person, not only from the Lindström declaration (which showed that a plateau was attained after about two hours), as, for commercial reasons, too long a retention time was not economically feasible.
- d) Since a longer retention time provided better yield and beatability, the problem solved over D1 was to provide a continuous process for cooking lignocellulosic material attaining improved yield and beatability at a low kappa number. The problem solved could also be formulated as how to implement the procedure of Example 5 of D1 in a continuous process for cooking lignocellulosic material attaining high yield, good beatability and low kappa number.

*Obviousness*

- e) D1 did not teach that a longer retention time was important in order to improve yield. On the contrary, the statements in D1 concerning the susceptibility of hemicellulose to degradation in the cooking liquor did not motivate the skilled

person towards increasing the retention time. It was not apparent whether the storage of the transfer liquor, which was implicit in the batch process illustrated by Example 5 of D1 (i.e. between drawn off, transfer and return of liquor) produced any particular effect on the yield. The claimed retention time was far away from the retention times (15 and 20 minutes) illustrated in the examples of D1, which did not concern continuous processes.

- f) D2 concerned the precipitation of organic substances and disclosed a longer retention time of up to 3 hours. However, this was in connection with precipitation of lignin, which negatively affected the kappa number. A high kappa number was acceptable according to D2, as apparent from the paragraph bridging columns 1 and 2 thereof, where D1 was acknowledged. This was, however, contrary to the teaching of D1 and of the patent in suit. Also, in D2, a longer retention time was linked to a strong reduction of the pH. This was apparent from the low pH values illustrated e.g. in Example 7 thereof. So the prolonged retention time and the better yield disclosed by D2 were inextricably linked to the strong lowering of the pH illustrated by D2. In this respect, the decision under appeal was correct. D2 had to do with a different process, which was not compatible with that of D1. The combination of D1 and D2 was based on ex-post facto considerations.
- g) Even if the problem were formulated as the provision of an alternative process, as invoked by the appellant, the very same arguments applied in favour of the non-obviousness of the claimed

solution. Also, the alleged possibility for the skilled person to change so many process parameters showed that changing retention time was not routine.

### **Reasons for the Decision**

1. The appeal is admissible.

#### *Main Request - Inventive step*

2. The invention
  - 2.1 The invention concerns a method for continuous cooking of lignocellulosic fibre material (Claim 1, Point II, *supra*).
  - 2.2 The method according to the invention is supposed to provide good yield and beatability and a low kappa number (patent in suit, paragraph [0007]).
3. The closest prior art
  - 3.1 Generally speaking, document D1 (e.g. Figure 1), as the patent in suit, relates to a method for the cooking of lignocellulosic fibre material, wherein a spent liquid, rich in hemicellulose, is withdrawn in an early phase of the cooking step and is added again to the fibre material at the final stage of the cook, in order to precipitate hemicellulose onto the pulp fibres. D1 (e.g. column 1, lines 33-35), like the patent in suit is concerned with a method for increasing pulp yield.
  - 3.2 For the board, D1 is the closest prior art document, considering that it addresses similar issues and

discloses a process similar to that according to the invention. At the oral proceedings, it was also common ground between the parties that D1 was the most appropriate starting point for the assessment of inventive step.

3.3 More particularly, D1 (Claim 1) concerns a process for the preparation of cellulose pulp, wherein cellulosic materials are digested with an alkaline cooking liquor at an elevated temperature in a cooking period, the process comprising drawing off from 50 to 75% by volume of the cooking liquor during an early stage of the cooking period, when the proportion of hemicelluloses therein is in the range 0.1 to 6% based upon the cellulosic material being digested, and admixing said withdrawn liquor with cellulose pulp and cooking liquor during the final stage of the cooking period, whereby hemicelluloses in said withdrawn liquor are absorbed on the pulp without substantial degradation of said hemicelluloses.

3.3.1 Example 5 of D1 (read where and as necessary in combination with Example 1) illustrates a process for sulphate cooking of commercial birch chips (hence, hardwood) carried out in acid-resistant autoclave tubes containing 300 g of chips (dry basis) at a liquid-to-wood ratio of 4 and with a charging of sodium hydroxide and sodium sulphide in such quantities that the alkali ratio, calculated as effective alkali, was 22.5% and the sulphidity 25%. Charging took place at 70°C. The temperature was increased linearly from 70°C to 170°C in 2 hours. The cooking time at 170°C was one hour. A cooking liquor was drawn off through a cooling coil 10 minutes before the maximum temperature, 170°C, was reached. The withdrawn cooking liquor was reinjected (liquor transfer) into the digester after the cooking

period, whereupon the temperature was maintained at 160°C for 20 minutes. The pulp was washed, defibrated and screened, whereupon yield, kappa number and brightness were determined.

Compared to cooking without liquor transfer (as in Example 1 of D1), the method of Example 5 of D1 attains a better screened yield percent value (52.2 versus 50.1) as well as a lower Kappa number (17.0 versus 17.6). In a parallel cook, in which 200 ml of 0.6 M sulphuric acid were also injected into the autoclave after the cooking liquor, a screened yield percent of 53.7 and a kappa number of 19.0 were obtained. Hence, addition of acid, i.e. lowering of the pH, is shown to further improve the yield obtained by the liquor transfer only.

3.3.2 Although Claim 1 of D1 does not specify whether the process is continuous, and Example 5 clearly concerns a batch process, there are at least two instances in D1, from which it can be directly and unambiguously gathered that the measures proposed in D1 are suitable for and intended to be applied in the context of continuous processes. The first instance is the passage of D1 introducing and dealing with the liquor transfer (Column 2, lines 18-22, particularly line 19), the main aspect of the invention of D1. The second instance is the sole figure of D1 and its relevant description starting from Column 3, line 63, up to Column 4, line 6. Reference is made in particularly the specific mention of "continuous" in Column 3, lines 64 and 68). Hence, D1 discloses continuous processes.

3.4 As regards the further features of claim 1 at issue that are, according to the respondent not disclosed in D1, i.e. the impregnation step, the Board notes that



Claim 1, apart from the mention of the impregnation liquid (alkali metal hydroxide), does not specify what kind of impregnation is carried out, let alone whether it is done in a one or two-vessel system. D1 expressly mentions that the digestion is alkaline (Claim 1) and illustrates the use of sodium hydroxide in its examples. The heating zone of the only figure of D1 is fed with steamed chips and conventional alkaline cooking liquor (Column 3, lines 66-73). This mixed feed is then progressively heated to the digestion temperature.

Hence, an impregnation of the chips with the alkaline liquor inevitably takes place before the actual cook starts.

Thus, for the board, the impregnation step of Claim 1 does not distinguish the claimed process from that of D1.

3.5 Hence, in the Board's judgement, D1 indeed discloses a process with all of the features of Claim 1 as granted apart from a retention time of at least 1 hour in the fourth stage.

4. The technical problem according to the respondent

4.1 Both the application as filed (page 2, lines 13-21) and the patent in suit (paragraph [0007]) mention that the invention was concerned with the problem of achieving good yield and beatability and a pulp with a low kappa number, in a context in which D1 was not acknowledged as prior art. At the the oral proceedings before the Board, the respondent however held that in the light of D1 taken as the closest prior art, the technical problem consisted in the provision of a continuous process for cooking lignocellulosic material resulting

in improved yield and beatability and pulp with a low kappa number.

- 4.2 Independently from whether such a new formulated problem actually finds basis in the application as filed, the question which arises (*infra*) is whether the respondent convincingly showed that this problem, which is regarded as being more ambitious than the one stated in the application as filed, is successfully solved across the whole breadth of Claim 1 of the main request. In this respect, see e.g. decision T 1188/00 of 30 April 2003, Point 4.5 of the Reasons.

5. The solution

As a solution thereto, the patent in suit provides the continuous method of cooking lignocellulosic fibre material according to claim 1 (Point II, *supra*), which method is characterised in particular in that it comprises step (d), namely:

"(d) in a fourth stage, cooking the fibre material in a cooking liquor comprising the liquid added in the third stage, whereby the fibre material is subjected to a **retention time of at least 1 hour** in said fourth stage" (emphasis added).

6. Alleged success of the solution

- 6.1 The board is not convinced that the evidence on file permits concluding that the process according to claim 1 at issue is effectively improved in comparison to the process according to the closest prior art D1, let alone across the whole breadth of Claim 1, the reasons being as follows:

- 6.1.1 Document D1 was not taken into account in the application as filed, i.e. when the problem stated in the patent in suit (paragraph [0007]), i.e. achieving *"good yield and beatability with a cost effective method to produce a pulp with a low kappa number while preserving good strength properties"* was formulated.
- 6.1.2 Figure 9 and the relevant description in paragraph [0035] of the patent in suit concern the screened yield and the kappa number of a pulp obtained from a cooked softwood pulp, in which either softwood or hardwood black liquor is recycled (the reference being a cooked softwood pulp without liquor transfer). The results confirm that recycling of softwood or hardwood black liquor improves (more with recycled hardwood than with recycled softwood) the yield, without greatly affecting the kappa number, in comparison to a process without liquor recycling.
- The appellant did not argue, let alone show, that the kappa number range illustrated by Figure 9 of the patent in suit is not low. Hence, the liquor transfer, as also taught by D1, is not an arbitrary measure and favours pulp yield without greatly affecting the kappa number. The results shown in Figure 9 cannot, however, be considered to represent a comparison with D1, as Example 5 of D1 concerns cooked hardwood pulp.
- 6.1.3 The results of the beatability tests mentioned in paragraph [0036] of the patent in suit, i.e. that less mechanical energy is required for beating when liquor from soft- or hardwood is added to the cooking, have not been contested. However, it is not in dispute that they do not represent a comparison with the method of D1 either.

6.1.4 As regards the Lindström declaration, the following is noted:

(a) the experiment underlying this declaration was carried out on spruce chips, whereby spruce is softwood, in any case softer than birch used in D1, so no comparison with Example 5 of D1 can be made. As no comparison with D1 can be made, the alleged contradiction between this declaration and Example 5 of D1, having regard to the statement in the declaration that "a small positive effect was noticeable first after some 50-60 minutes", is thus not existing, or not convincing. As regards the doubts cast on the quality of the xylan rich liquor (i.e. that a content of 8% xylan, is rather unusual), the declaration itself acknowledges that the level is relatively high. This however does not appear to be in contradiction with the statement in the patent in suit, that softwood might contain up to 10% xylan, which statement has not been objected to. In fact, Figure 9 too appears to show that a xylan rich liquor from hardwood gives the best result. This might explain why in the declaration a liquor with relatively high level of xylan is used. So no contradiction is apparent between the declaration and Figure 9 of the patent in suit. In any case, it has not been proven that the xylan liquor used in the declaration is particularly unusual.

(b) The chemistry stated to be underlying the illustration in the declaration, in particular the precipitation of HexA-freed xylan during kraft pulping, has not been called into question by the appellant. This chemistry shows a causal relationship between long retention time and more

complete precipitation of said xylan. Hence, the declaration shows that a long retention time as claimed is not an arbitrary measure. Although this is shown for softwood, it appears to likewise apply to hardwood, which normally contains more xylan. Hence, it is plausible that the causal relation between long retention time, more complete precipitation of said xylan and better pulp yield holds for hardwood too.

- (c) As regards the objection that the Lindström declaration invokes a more pronounced improvement than is shown in Figure 9 of the patent in suit, the board notes that the experimental results respectively presented therein are not directly comparable. In fact, Figure 9 concerns the relation between screened yield and kappa number, whereas the figure of the declaration concerns the relation between screened yield and time.

Summing up, the declaration by Lindström does not demonstrate any improvement over the process of D1.

- 6.1.5 Therefore, neither the examples of the patent in suit nor the Lindström declaration reflect the closest prior art D1, e.g. in terms of the achievable pulp yield or beatability. Hence, no improvement whatsoever achievable by the claimed method across the whole breadth of Claim 1, over the method of D1, has been made plausible or demonstrated by evidence.

## 7. Reformulation of the technical problem

- 7.1 Since the technical problem cannot be formulated in terms of an improvement over the closest prior art D1, it must be reformulated in a less ambitious manner.

7.2 In the light of the closest prior art D1 a less ambitiously formulated technical problem can be seen in the provision of a further method for continuous cooking of lignocellulosic fibre material providing good pulp yield and beatability and pulp with a low kappa number, as proposed in similar words by the respondent at the oral proceedings (see point XII d), *supra*).

8. Success of the solution

8.1 Considering that the Lindström declaration makes it plausible that a long retention time is not unfavourable to good yield and pulp with low kappa number, the board accepts that this less ambitious technical problem is successfully solved by the claimed process.

8.2 The appellant argued that a low kappa number has no corresponding measure in Claim 1, so that it cannot be taken into consideration when formulating the problem effectively solved. In other words, this means that a process with the features of claim 1 at issue will not necessarily result in a low kappa number. This argumentation is not convincing for the following reasons:

The patent in suit mentions, as one of the objectives of its method, low kappa number (column 2, line 36); Figure 9 illustrates the results of improved yield in relation to kappa number, as a function of recycled black liquor, which recycling is mentioned in Claim 1. Moreover, D1, i.e. the closest prior art, likewise emphasises the prevention of lignin precipitation. Claim 1 is directed to a method for continuous cooking

of lignocellulosic fibre material, whereby, as stated by the respondent, the control objective is to cook to a desired kappa number. The patent in suit does mention (column 12, lines 30-36) the possible addition of an acid to lower the pH and precipitate hemicelluloses, especially xylan, however in a separate stage not being part of the cooking. Claim 1 at issue instead defines a fourth cooking stage, which does not comprise any measure likely to cause precipitation of lignin. Hence, prevention of lignin precipitation, which means keeping the sought-for kappa number low, is definitely an (implicit) objective of the claimed process.

*Obviousness*

9. It remains to be assessed whether the skilled person starting from the method according to the closest prior art D1 and trying to solve the technical problem posed, would, in the light of the prior art and common general knowledge relied upon by the appellant, obviously consider modifying or implementing the method of D1 such as to arrive at a method falling within the terms of claim 1 at issue, i.e. with a retention time of at least one hour. This assessment essentially boils down to the question of whether, and for which reasons, the skilled person would be induced to consider and adopt this measure.
  
10. Document D1 taken alone
  
- 10.1 According to Example 5 of D1 the hemicelluloses (xylan)-rich liquid withdrawn from the cook before reaching maximum temperature and reintroduced into the final stage, is retained in the final cook for 20 minutes at 160°C.

- 10.2 The further examples of D1 deal with several alternatives in order to improve hemicelluloses (xylan) adsorption onto the wood fibres (hence, to improve pulp yield), such as: addition of  $H_2SO_4$ , to lower the pH, thus enhancing precipitation (Example 5, parallel cook); cooling the hemicelluloses rich liquor before reintroduction to the cook (Example 9); and, immediate injection of the withdrawn liquor into a parallel cook (i.e. without any intermediate storage or re-adsorption promoting step) (Examples 6 to 11). Even when the withdrawn hemicelluloses-rich liquor is directly re-injected into a parallel cook started earlier, the last stage cook time after re-injection is no longer than 15 minutes.
- 10.3 From this, the Board deduces that the storage time implicit to Example 5, i.e. the time from withdrawal to re-injection of the hemicelluloses-rich liquor, on which D1 is silent, has no special significance, and cannot hint at prolonging the retention time.
- 10.4 D1 thus suggests several alternative possibilities of increasing the yield, none of which involves a substantial prolongation of the retention time in the last stage of the cook, into which hemicelluloses-rich liquor has been reintroduced, beyond the 15 or 20 minutes exemplified in D1.
- 10.5 Hence, D1 taken alone definitely does not hint at prolonging the retention time of the last cook stage containing the re-injected hemicelluloses-rich liquor to the claimed duration of "at least one hour".



11. Regarding the invoked combination of document D1 with Document D2

11.1 Disclosure and teaching of document D2

11.1.1 D2 (Claim 1) concerns a method of preparing pulp by alkaline digestion of cellulosic material, which comprises digesting said cellulosic material containing organic substances in an alkaline digestion liquid at a temperature of from 50°C to 200°C to give a pulp yield of not above 65 percent, lowering the pH of the digestion liquid to below 11 in the presence of the pulp to precipitate out at least 5 percent, based on said cellulosic material, of organic substances dissolved in the digestion liquid, and then continuing said digestion at a temperature of 50°C to 200°C until a large percentage of said precipitated organic substances have been absorbed by the pulp during an absorption period.

11.1.2 Preferably, the process of D2 comprises continuing the absorption period from 5 minutes to 300 minutes (Claim 4).

11.1.3 The method according to D2 (column 2, lines 9-18) is characterised in particular in that subsequent to digesting the cellulosic material for a certain length of time, measures are taken whereby at least 5% (calculated on the cellulosic starting material) and preferably at least 10% of dissolved organic substances are precipitated out. By proceeding in this manner, significant quantities of lignin are precipitated out in addition to hemicelluloses.

11.1.4 This re-precipitation of substances can be conveniently achieved by lowering the pH of the cooking liquor to

beneath 11, e.g. by introducing an acid thereto (column 2, lines 17-21), in order to precipitate significant quantities of lignin.

11.1.5 Still according to D2 (Column 2, lines 32-40), in order for the re-precipitation of dissolved substances to have any practical significance with regard to an increase in pulp yield, the digestion process should be continued to an extent corresponding to a pulp yield of approximately 65% (calculated on the wood) preferably 60%. The possible increase in yield afforded by the precipitation of substances dissolved in the cooking liquor becomes greater the longer the digestion process is continued.

11.1.6 Examples 6 and 7 of D2 concern the digestion of laboratory pine chips (i.e. wood which is softer than birch used in D1) and show that by prolonging the retention time in the last cook stage (i.e. after injection of acid) from 15 minutes to 5 hours (300 minutes) the total yield can be improved from 62.2. to 67.0.

11.2 Regarding the combinability of D1 and D2

11.2.1 The reformulated technical problem (Point 7.2, *supra*) includes the achievement of a pulp having a low kappa number. Whereas in the method of D1 an undesired precipitation of lignin is prevented, the method of D2 includes the deliberate choice of substantially precipitating the lignin, which goes along with an increase of the kappa number.

Hence, the board finds that the skilled person, starting out from D1, would not have considered the

contents of D2 at all when trying to solve the technical problem posed.

11.2.2 Even assuming for the sake of argument and in favour of the appellant, that the skilled person would none the less consider document D2, the Board is not convinced that he could gather from the latter that a substantially prolonged retention time in the last cook stage of the method according to D1 would lead to improved precipitation of hemicelluloses such as xylan, hence to good yield and beatability, without, however, leading to substantial precipitation of lignin and, hence, an undesirably high kappa number, not least in view of the following considerations:

11.2.3 Both D1 and D2 teach lowering of the pH in order to precipitate dissolved substances. However, whilst according to D1 the pH is lowered to at most 11.5 in order to precipitate substantially only the hemicelluloses (as also acknowledged in D2, paragraph bridging columns 1 and 2), according to D2 the pH is even lowered much more, e.g. down to about 5 as in Examples 6 and 7, in order to deliberately precipitate significant quantities of lignin. Although D2 mentions that the precipitation of dissolved substances becomes greater the longer the digestion is continued (column 2, lines 37-40), this indication directly follows the paragraph (column 2, lines 23-31) dealing with lowering of the pH and cannot, thus, be considered alone, as this does not reflect the overall teaching of D2.

11.3 Thus, in the Board's judgement, the subject-matter of Claim 1, and of claims 2 to 13 dependent thereon, involves an inventive step (Articles 52(1) and 56 EPC).

**Order**

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

The appeal is dismissed.

The Registrar:

The Chairman:



D. Magliano

B. Czech

Decision electronically authenticated