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D E C I S I O N
of 14 February 2003

Case Number: T 0130/99 - 3.3.6

Application Number: 90911518.0

Publication Number: 0487557

IPC: D21C 9/10

Language of the proceedings: EN

Title of invention:
Improvement of pulp bleaching

Patentee:
GENENCOR INTERNATIONAL EUROPE OY

Opponent:
Primalco Ltd.

Headword:
Bleaching method/GENENCOR

Relevant legal provisions:
EPC Art. 56

Keyword:
"Inventive step (yes) - incorporation into a reaction sequence (here manufacture of pulp for papermaking) of a treatment step leading to non-expected effects"

Decisions cited:
-

Catchword:
-

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Case Number: T 0130/99 - 3.3.6

D E C I S I O N
of the Technical Board of Appeal 3.3.6
of 14 February 2003

Appellant: (Opponent)
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Decision under appeal: **Interlocutory decision of the Opposition Division of the European Patent Office posted 1 December 1998 concerning maintenance of European patent No. 0 487 557 in amended form.**

Composition of the Board:

Chairman: P. Krasa
Members: P. Ammendola
C. Rennie-Smith

Summary of Facts and Submissions

I. This appeal is from an interlocutory decision of the Opposition Division concerning the maintenance of European patent No. 0 487 557 in amended form.

II. Independent claim 1 as maintained reads:

"*1. A method for the bleaching of oxygen delignified wood derived kraft pulp for papermaking, characterised in that said method includes a step in which the pulp is treated with a hemicellulose hydrolysing enzyme or enzyme preparation, said enzyme being derived from the genus Trichoderma or from Chainia sp. ATCC 53812; wherein said hemicellulose-hydrolyzing enzyme contains less than 0.5% (i.e. 1/200) of cellulase activity, and wherein said hemicellulose-hydrolyzing enzyme or enzyme preparation is added prior to the bleaching stage.*"

Dependent claims 2 to 8 related to particular embodiments of the method of claim 1.

III. In a notice of opposition, based on lack of novelty and of inventive step (Article 100(a) EPC), the Appellant (Opponent) cited *inter alia* the following documents:

Document (2) = Viikari L. *et al.*, "Application of enzymes in bleaching" Fourth International Symposium on Wood and Pulping Chemistry, Paris 1987, pages 151-154.

Document (3) = Senior D.J. *et al.*, "Selective solubilization of xylan in pulp using a

purified xylanase from Trichoderma Harzianum", Biotechnology Letters, vol. 10, no.12, 1988, pages 907-912.

Document (5) = Srinivasan M.C. *et al.*, "Studies on xylan degrading enzyme from Chainia", Biotechnology Letters, vol. 8, no.11, 1984, pages 715-718.

At the hearing before the Opposition Division the following document (cited in the original patent application and discussed during its examination) was also considered:

Document (4')= Singh R.P. *et al.*, "Oxygen Bleaching", in "The Bleaching of Pulp", Singh R.P. Ed., Tappi Press, Atlanta, 1979, pages 159-209.

IV. In its decision, the Opposition Division found that the subject-matter of claim 1 quoted above was novel and involved an inventive step. In particular, it held that Document (4') disclosed the most relevant prior art and that the skilled person seeking to produce papermaking pulp would not be motivated to combine the disclosure of Documents (4') and (2) with that of Document (3), since the latter concerned dissolving pulps only.

V. The Appellant appealed the above decision submitting that the subject-matter of claim 1 as amended was obvious in view of the combination of the disclosures of Documents (2) and (3) or (2) and (5).

It maintained that:

- oxygen bleaching and pulp treatment with enzymes were known *per se*;

- Document (2) disclosed that hemicellulase treatment might be carried out at conditions typical for oxygen bleaching, thereby producing additional lignin removal and, therefore, increased pulp viscosity, as well as reduced kappa numbers and chlorine consumption;

- Documents (3) and (5) described the hemicellulases free of cellulase activity defined in claim 1 of the patent in suit;

- the Opposition Division was wrong in considering that the person skilled in the art of papermaking would not read Document (3) since the disclosure in this Document was not limited to dissolving pulps.

The Appellant concluded that Document (2) suggests the use of hemicellulase treatments to provide additional delignification in oxygen bleaching of papermaking pulp and, therefore, that the use of the specific hemicellulases of Documents (3) or (5) in combination with oxygen bleaching of papermaking pulp could not be considered to involve an inventive step.

VI. The Respondent refuted the Appellant's arguments and submitted, in summary, that none of Documents (2), (3) and (5) provided information as to pulp delignification by hemicellulase treatments of previously oxygen-delignified pulp. In particular, it maintained that:

- none of these documents mentioned oxygen

delignification;

- Documents (3) and (5) did not even mention delignification at all;

- Document (2) did not disclose that the hemicellulase treatments produce further delignification, but only that the combination of such enzymatic treatments with subsequent chemical bleaching stages provided improved pulp delignification.

VII. The Appellant requested that the decision under appeal be set aside and the patent be revoked.

The Respondent requested that the appeal be dismissed and that the patent be maintained in accordance with the decision under appeal.

Reasons for the Decision

1. *Novelty (Articles 52(1) and 54 EPC) and the requirements of Articles 84, 123(2) and (3) EPC*

The Board is satisfied that the subject-matter of the claims maintained by the Opposition Division is novel (Articles 52(1) and 54 EPC) and that the patent as maintained complies also with the requirements of Articles 84, 123(2) and (3) EPC.

It is not necessary to give further details since no objections were raised by the Appellant in this regard during the appeal proceedings.

2. *Inventive step concerning the subject-matter of claim 1 (Article 56 EPC)*

2.1 Claim 1 describes a method for bleaching kraft wood pulp which has been delignified with oxygen and which is useful for papermaking. It is characterized by the fact that prior to the bleaching stage the oxygen-delignified pulp is treated with specific hemicellulose hydrolysing enzymes with limited cellulase activity.

2.2 The patent in suit defines at page 2, lines 33 to 34, the technical effect to be achieved in the claimed method as "*to reduce the amount of chlorine-containing agents and sodium hydroxide used in pulp bleaching processes*". Referring in the description to the background art (at page 2, lines 11 to 22), the patent explains that, even though the oxygen delignification makes it possible to diminish the amount of chlorine containing agents and sodium hydroxide used in bleaching plants of many paper mills, extensive pulp delignification cannot be achieved by oxygen treatments without causing extensive depolymerization of carbohydrates and the resulting reduction of the paper properties. The patent then states that it was not known how to extend the delignification of pulp by using reduced amounts of chlorine, sodium hydroxide and oxygen.

Accordingly, it is apparent that the patent addresses the technical problem of reducing the amount of chemicals consumed in the conventional treatment sequence of pulp for papermaking:

[oxygen delignification] + [final chemical bleaching].

2.3 Document (4')(see in particular Figure 7.8 and page 170, lines 32 to 39) describes the reduced selectivity for delignification as the "gap" that renders the oxygen delignification (indicated as "oxygen bleaching") less efficient than the conventional chemical delignification (indicated as "pre-bleaching") of pulp. Of course, this "gap" in the efficiency of delignification evidently implies that larger amounts of chemicals must be used in the final bleaching of oxygen delignified pulp.

None of the other available documents mentions the unsatisfactory delignification obtainable by oxygen bleaching and/or of the relatively high amounts of chemicals used in the subsequent final bleaching stage.

Therefore, the Board concludes that the decision under appeal correctly identifies the most relevant state of the art in the conventional processes disclosed in Document (4'), wherein a partial delignification of the pulp by oxygen treatment is followed by the final chemical bleaching with high consumption of chlorine chemicals.

2.4 It is undisputed that the examples in the patent in suit convincingly demonstrate that the lignin content of the oxygen-delignified pulp is actually reduced during the hemicellulase treatment in the method of claim 1 (see in particular page 5 lines 30 to 35 of the patent in suit) and hence that in the claimed method less chemical bleaching is required to achieve a target brightness of 85-90% than in corresponding process sequences with no enzyme treatments, i.e. in processes sequences representing the conventional bleaching of pulp for papermaking of Document (4') comprising an

oxygen delignification stage.

Accordingly, the Board concludes that the method of claim 1 has credibly solved the problem addressed in the patent in suit (see at point 2.2) which, therefore, is accepted as underlying the claimed invention.

2.5 The method of claim 1 differs from those of the prior art identified above (see point 2.3) in that the oxygen-delignified pulp is treated with specific hemicellulose hydrolysing enzymes with limited cellulase activity prior to the final bleaching stage.

2.6 Therefore, to answer the question of obviousness it is necessary in the present case to determine whether or not the person skilled in the art of papermaking would have modified the conventional sequence [oxygen delignification] + [final bleaching] by interposing therein a treatment with the hemicellulases defined in claim 1, with a reasonable expectation of success in reducing the amounts of chemicals needed in the final bleaching stage.

2.7 Document (2) relates to peroxide bleaching and bleaching with chlorine chemicals (page 152, left hand column) but not to oxygen bleaching. However, the Appellant maintained that Document (2) disclosed that hemicellulase treatments may be used "*in connection with oxygen bleaching or delignification*" (see page 2, lines 10 to 11 from the bottom, of the statement setting out the grounds of appeal). It further submitted that the disclosure in this document made it obvious for the skilled person also to use a hemicellulase treatment in bleaching processes comprising oxygen delignification in order to improve

delignification further and, therefore, to reduce the amount of chemicals used.

In the statement of grounds of appeal it is not explained why the hemicellulase treatments disclosed in this document related to oxygen delignification. However, it seems from the final paragraph at page 3 of this statement that the Appellant has seen this connection resulting from the assumption that the treatment sequence of Document (2) comprising delignification with peroxides was alleged to "*at least partially simulate oxygen delignification*" (page 3, lines 10 to 11 from the bottom). This last allegation was then considered implicitly confirmed by the unusual presence of magnesium sulphate in such peroxide delignification.

2.8 The Board finds that Document (2) is silent as to oxygen delignification of pulp and that oxygen and peroxide delignification are substantially different processes. The Appellant's assumption that the presence of magnesium sulphate in the peroxide delignification of Document (2) demonstrates the similarity of this peroxide delignification to the specific oxygen delignification disclosed in Document (4') remains, in the absence of further evidence, a mere allegation.

Therefore, and considering also the particular requirements for the treatment of pulps intended for papermaking (see Document (4') page 159, the last paragraph), the Board cannot accept this assumption.

On the other hand, the Board observes that the very fact that this document discloses the beneficial effects of hemicellulase treatments on delignification

and chlorine consumption in other pulp bleaching processes is sufficient to suggest to the skilled person that the same effects were also to be expected if, in the conventional pulp bleaching processes comprising an oxygen delignification stage, an enzymatic delignification stage where to be added.

2.9 The Board notes however that the skilled person also derives from Document (2) the clear instruction that this beneficial hemicellulase treatment must be carried out on untreated pulp. This is evident when considering that Document (2) discloses exclusively pulp bleaching sequences in which the hemicellulase treatment **precedes** a delignification stage with peroxides or a bleaching stage with chlorine chemicals. In particular, the section headed "(DC)EDED-bleachings" in Document (2) discloses that the enzyme treatment is carried before the "(DC)E-prebl." (see page 154, left hand column, in particular Table 8), which clearly means that the hemicellulase treatment is carried out even before the "pre-bleaching" stage.

Therefore, Document (2) discloses only two pulp treatment sequences:

(I) [enzyme treatment] + [peroxide delignification]

or

(II) [enzyme treatment] + [pre-bleaching with chlorine] + [final bleaching with chlorine].

In both sequences the hemicellulase treatments are made on untreated pulps, i.e. **before** any chemical treatment.

It is stressed that the Appellant's allegation that the peroxide treatment of sequence I of Document (2) was a treatment corresponding to oxygen delignification has no bearing on this conclusion, since the peroxide delignification stage of sequence I of Document (2) is also carried out after the treatment with hemicellulase.

2.10 Apart from Document (2), the only other document disclosing the use of hemicellulases on pulp is Document (3), which describes the action of these enzymes either on untreated pulp or on an unspecified "bleached kraft hardwood pulp".

Document (3) does not indicate whether or not the pulp considered therein is a pulp for papermaking.

However, Document (3) (as well as Document (5)) does not indicate that the action of the hemicellulase produces further lignin removal, but only hydrolysis of hemicellulose. Therefore, even if one assumed for the sake of argument that the "bleached pulp" in the examples of Document (3) was a pulp for papermaking delignified with oxygen, still this document would not disclose that the use of the hemicellulase from Trichoderma provided substantial further removal of lignin therefrom.

2.11 Thus the only substantial delignification of pulp by hemicellulose treatments disclosed in the available prior art is that obtained in the bleaching sequences of Document (2) - in which the enzyme treatment is carried out on untreated pulp - and the Appellant has provided neither arguments nor evidence demonstrating that the hemicellulase enzyme treatments disclosed in

Document (2) may also produce substantial delignification of pulp already treated with oxygen.

Therefore, the Board concludes that the available state of the art neither explicitly suggests to the skilled person to interpose a hemicellulase enzyme treatment between the first chemical delignification with oxygen and the final bleaching of pulp for papermaking, nor demonstrates that the hemicellulase treatments known from Document (2) may reasonably be expected to provide substantial further delignification of pulp already delignified with oxygen.

Consequently, it is not apparent to the person skilled in the art that a hemicellulase treatment of oxygen delignified pulp may result in the solution of the technical problem of reducing the amounts of chemicals needed in the bleaching of pulp for papermaking.

Therefore, the subject-matter of claim 1 is not rendered obvious by the available state of the art and thus complies with the requirements of Article 56 EPC.

3. *Inventive step concerning the subject-matter of claims 2 to 8 as maintained*

The dependent claims 2 to 8 define preferred embodiments of the method of claim 1 and, therefore, their subject-matter involves an inventive step for the same reasons given above for claim 1.

Order

For these reasons it is decided that:

The appeal is dismissed

The Registrar: The Chairman:

G. Rauh P. Krasa