



Europäisches Patentamt
European Patent Office
Office européen des brevets



Publication number: **0 429 422 A1**

12

EUROPEAN PATENT APPLICATION

21 Application number: **90850371.7**

51 Int. Cl.⁵: **D21C 3/00**

22 Date of filing: **13.11.90**

30 Priority: **17.11.89 FI 895501**

43 Date of publication of application:
29.05.91 Bulletin 91/22

84 Designated Contracting States:
DE FR GB SE

71 Applicant: **ENSO-GUTZEIT OY**
Kanavaranta 1
SF-00160 Helsinki(FI)

72 Inventor: **Vaheri, Marja**
Lystimäenkuja 1A
SF-02210 Espoo(FI)
Inventor: **Salama, Nina**
Servin Maijantie 12A 8
SF-02150 Espoo(FI)
Inventor: **Ruohoniemi, Kimmo**
Harakantie 586 as 8
SF-55800 Imatra(FI)

74 Representative: **Nilsson, Karl et al**
STENHAGEN PATENTBYRA AB Box 17 709
S-118 93 Stockholm(SE)

54 Procedure for the production of pulp.

57 The invention relates to a procedure for the production of mechanical pulp from a fibrous product. To reduce the refining energy, the fibrous product is subjected to an enzyme treatment in which an enzyme acts on the lignin in the fibrous product. When oxidizing enzymes are used, it is preferable to adjust the redox potential to the optimum level characteristic of each oxidation-reduction enzyme by means of suitable oxidation-reduction chemicals. In addition to reducing the refining energy consumption, the enzyme treatment also improves the strength properties and the blue reflectance factor of the pulp.

EP 0 429 422 A1

PROCEDURE FOR THE PRODUCTION OF PULP

The present invention relates to a procedure for the production of mechanical pulp from a fibrous product.

The production of mechanical pulp from a fibrous product, such as whole wood, wood chips, chips or refined pulp is mainly implemented by mechanical methods. The production of mechanical pulp is based on the utilization of friction. Energy is transferred to the wood in a compress-release process generating frictional heat which softens the wood so that individual fibres can be released.

Traditionally, mechanical pulp is produced either by grinding or refining. These methods have the disadvantage of a high energy consumption, but they also have the advantage of a high yield (about 95%). In the more advanced versions of the refining method, heat (TMP, thermomechanical pulp) and possibly also chemicals (CTMP) are used. Moreover, it has recently been established that the energy consumption in the defibration and refining of wood can be reduced by allowing white-rot fungi to act either on wood chips or on pulp produced by a single refining operation. However, this method has the disadvantage that the required reaction time is several days, even weeks. Besides, the reaction requires sterile conditions. These circumstances are an obstacle to large-scale and economical utilization of the method.

The object of the present invention is to create a solution that allows the refining energy requirement to be reduced from its present level. The invention is characterized in that the fibrous product is subjected to an enzyme treatment in which an enzyme acts on the lignin in the fibrous product. When the fibrous product is treated with enzymes acting on lignin, generated e.g. by white-rot fungi, in the presence of suitable deoxidants, antioxidants or salts, a reduction in the refining energy is achieved even if a short reaction time is used, and no sterilization of the raw material is necessary.

In the procedure of the invention, the raw material subjected to enzyme treatment may be either whole wood, wood chips, or pulp refined one or more times. However, the enzyme action requires a good contact with as large a fibre area as possible.

The purpose of the enzyme treatment is to modify the structure of the lignin in the fibres in such a way that the fibres will come apart more easily during mechanical refining. The desired result is achieved by treating the fibrous product with an oxidizing enzyme and adjusting the redox potential with a suitable oxidation-reduction chemical. The enzyme to be used is preferably phenoloxidase, lignin peroxidase, manganese peroxidase or a mixture of these. A suitable enzyme is the phenoloxidase or laccase produced by white-rot fungus *Coriolus versiculum*. The temperature range of the enzyme treatment may be 10-90 °C, preferably 40-70 °C, and the pH range 2.0-10.0, preferably 4.0-8.0. When oxidizing enzymes such as phenoloxidase, lignin peroxidase and manganese peroxidase are used, it is preferable to adjust the redox potential to the optimum level characteristic of each oxidation-reduction enzyme by means of suitable oxidation-reduction chemicals or redox regulators, e.g. gaseous nitrogen or oxygen, antioxidants, sugars or sugar derivatives, organic acids or inorganic salts, used either by themselves or in mixtures.

In the following, the invention is described in detail by the aid of examples of embodiments based on laboratory tests.

Example 1.

2000 g of once-refined TMP spruce wood pulp was elutriated in tap water so that the mixture obtained had a consistency of 2.9%. By adding *Coriolus versiculum* laccase enzyme to the mixture, a mixture with a laccase activity of 0.5 U/ml and an initial redox potential of approx. 100mV as measured against the Pt-electrode was obtained. The temperature of the mixture during the enzyme treatment was 20 °C and the treating time was 30 min.

After the enzyme treatment, sodium hydroxide (in an amount of 4% of the dry matter of the mixture) was added to the mixture. The mixture was then stirred manually for 30 min., whereupon it was concentrated, centrifugalized, homogenized and frozen.

The pulp was refined in a Sprout Waldron d 30 cm refiner with a diminishing blade distance. The refining energy was measured, whereupon a sample of 200 g (average) was taken. The sample was analyzed to determine its freeness value (CSF), fibre distribution, fibre length and shives content. In addition, a circulation water sheet was produced from the sample and analyzed to determine its density, tensile index, tear index, light scattering coefficient, light absorption coefficient and blue reflectance factor.

Tables 1 and 2 show the results of the analytical tests reflecting the refining result and the quality of the pulp.

In addition to the above-described test (test 3) illustrating the invention, two reference tests (tests 1 and

2) and two additional tests (tests 4 and 5) were carried out. The results of these tests are also presented in Table 1 below. The tests were performed as follows:

5 Test 1 (reference test): No enzyme treatment and no water treatment of the pulp was carried out before refining. Neither was the pulp subjected to an alkali treatment. The refining and analyses were performed as above (test 3).

Test 2 (reference test): No enzyme treatment of the pulp was performed, but the pulp was treated with tap water in conditions corresponding to those of the enzyme treatment in test 3. In all other respects, the treatment corresponded to that described above (test 3).

10 Test 4: The pulp was subjected to an enzyme treatment in which the reaction mixture contained ascorbic acid in an amount of 0.3 g/l. Otherwise the test corresponded to that described above (test 3). The procedure represented by this test is within the scope of the present invention.

15 Test 5: The pulp was subjected to an enzyme treatment in which the reaction mixture contained ascorbic acid in an amount of 0.3 g/l and 10 mM of sodium chloride. Otherwise the test corresponded to that described above (test 3). The procedure represented by this test is within the scope of the present invention.

It can be seen from the results that the refining energy can be reduced during the first refining operation if once-refined TMP pulp is subjected to an enzyme treatment as provided by the invention.

It can also be seen that the the blue reflectance factor and certain strength properties were better than in the case of the control pulp.

20 It is obvious to a person skilled in the art that the invention is not restricted to the embodiment described above, but that it may instead be varied within the scope of the following claims.

25

30

35

40

45

50

55

TABLE 1

		TEST 1	TEST 2		TEST 3		TEST 4		TEST 5	
5	Name of pulp	Untreated pulp	M0 0	I	M1 0	I	M2 0	I	M3 0	I
	Solids content % abt.	30	33.09	37.06	33.31	30.02	32.56	31.91	32.64	30.72
	CSF	410	410	330	410	320	410	315	410	315
10	RESEARCH CENTRE	0	1	2	4	5	7	8	10	11
	Degree of beating ° FR	380	421	315	397	292	390	298	382	303
	Shives content %	2.36	1.58	0.83	1.83	1.43	2.80	1.45	2.25	0.88
	Loss %	12.64	8.16	7.46	9.23	6.46	9.80	7.29	13.29	8.54
15	Bauer McNett classification									
	30-fraction %	45.0	47.1	44.2	47.3	46.6	46.6	44.2	46.1	43.4
	50-fraction %	24.7	23.7	24.0	24.1	24.2	25.0	25.2	24.8	24.8
	100-fraction %	7.7	7.3	7.0	7.6	7.4	7.6	7.5	7.8	7.6
20	200-fraction %	4.5	4.7	4.8	4.7	4.7	4.6	4.6	4.4	4.4
	Pass-through %	18.6	17.2	20.0	16.3	17.1	16.2	18.5	16.9	19.8
	Fibre length Kajaani FS 200									
25	Arithm. average mm	0.51	0.48	0.44	0.50	0.49	0.50	0.49	0.48	0.50
	L weight mm	1.31	1.30	1.21	1.30	1.33	1.33	1.31	1.33	1.31
	W weight mm	1.88	1.92	1.81	1.86	1.94	1.93	1.92	1.96	1.92
	0.20 mm p %	44.34	46.68	48.60	45.11	46.07	44.92	45.04	47.70	43.65
	0.20 mm w %	7.19	7.77	8.97	7.37	7.58	7.21	7.50	7.98	7.03
30	Circul. water sheets no.	0	1	2	4	5	7	8	10	11
	Grammage g/m²	62.7	61.2	61.5	66.1	64.5	64.3	61.2	60.3	60.0
	Thickness µm	226	208	194	220	198	218	192	203	185
	Density kg/m³	277	294	317	300	326	295	319	297	323
	Tensile index Nm/g	19.6	19.1	24.9	21.2	25.6	21.8	25.9	21.8	27.0
35	Elongation %	1.5	1.3	1.6	1.5	1.6	1.5	1.7	1.5	1.5
	Tear index mNm²/g	5.38	5.88	6.67	5.79	6.90	5.56	6.94	5.82	6.08
	Light scatt.coeff. m²/kg	46.0	43.0	42.0	42.2	41.6	42.2	44.4	42.3	42.4
	Light abs. coeff. kg/m²	2.31	3.78	3.58	3.78	3.53	3.55	3.54	3.57	3.39
	Blue reflectance %	57.7	49.6	50.2	49.3	50.3	50.0	51.4	49.8	51.2

TABLE 2

	TEST 2		TEST 3		TEST 4		TEST 5	
45	Untreated pulp		Pulp with laccase		Pulp with laccase and ascorbic acid		Pulp with laccase, ascorbic acid and NaCl	
50	CSF	E MJ/kg	CSF	E MJ/kg	CSF	E MJ/kg	CSF	E MJ/kg
	410	1.35	410	1.27	410	1.35	410	1.16
	330		320		315		315	
55	E = refining energy CSF = freeness							

Claims

1. Procedure for the production of mechanical pulp from a fibrous product, **characterized** in that the fibrous product is subjected to an enzyme treatment in which an enzyme acts on the lignin in the fibrous product.
2. Procedure according to claim 1, **characterized** in that an oxidizing enzyme acts on the lignin in the fibrous product.
3. Procedure according to claim 1 or 2, **characterized** in that, when oxidizing enzymes are used, the redox potential is adjusted by means of suitable oxidation-reduction chemicals.
4. Procedure according to any of the preceding claims, **characterized** in that the oxidizing enzyme used is preferably phenoloxidase, lignin peroxidase, manganese peroxidase or a mixture of these, and the oxidation-reduction chemicals are preferably gaseous nitrogen or oxygen, antioxidants, sugars or sugar derivatives, organic acids or inorganic salts, used either by themselves or in mixtures.
5. Procedure according to any of the preceding claims, **characterized** in that the temperature range of the enzyme treatment is 10-90° C, preferably 40-75° C, and the pH range 2.0-10.0, preferably 4.0-8.0.
6. Use of enzymes acting on lignin to reduce the energy consumption in the production of mechanical pulp.
7. Use of an enzyme according to claim 6 to reduce the energy consumption in the production of mechanical pulp when oxidizing enzymes are used.
8. Use of an enzyme according to claim 5 to reduce the energy consumption in the production of mechanical pulp when an oxidation-reduction chemical is used.
9. Use of oxidation-reduction chemicals according to claim 6 to reduce the energy consumption in the production of mechanical pulp when the oxidation-reduction chemicals are gaseous nitrogen or oxygen, antioxidants, sugars or sugar derivatives, organic acids or inorganic salts, used either by themselves or in mixtures.
10. Use of phenoloxidase, lignin peroxidase, manganese peroxidase or a mixture of these according to claim 6-9, to reduce the energy consumption in the production of mechanical pulp.



EUROPEAN SEARCH
REPORT

EP 90 85 0371

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X,A	WO-A-8 700 564 (REPLIGEN CORPORATION) * page 3, line 17 - page 5, line 23 ** page 7, line 30 - page 8, line 14 ** claims 1, 9, 10 * - - -	1,2,4,5,6, 10	D 21 C 3/00
A	WO-A-8 803 190 (CALL H.P.) * page 2, line 20 - page 3, line 35; claims 1-15 * - - -	1-5,8,9	
P,X	TAPPI JOURNAL. vol. 73, no. 4, April 1990, ATLANTA US pages 198 - 204; Trotter P.C.: "Biotechnology in the pulp and paper industry: a review." * page 201, left-hand column, line 15 - page 202, middle column, line 58 * - - - - -	1,2,4,6,7, 10	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			D 21 C
The present search report has been drawn up for all claims			
Place of search		Date of completion of search	Examiner
The Hague		01 March 91	BERNARDO NORIEGA F.
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			