(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 595 386 B2

(12) NEW EUROPEAN PATENT SPECIFICATION

(45) Date of publication and mention of the opposition decision:
17.07.2002 Bulletin 2002/29

(45) Mention of the grant of the patent:
26.05.1999 Bulletin 1999/21

(21) Application number: **93202821.0**

(22) Date of filing: **04.10.1993**

(51) Int Cl.^{7}: **D21C 9/10**, D21C 9/16

(54) Process for bleaching of chemically digested lignocellulose-containing pulp

Verfahren zum Bleichen von chemisch aufgelösten Lignocellulose enthaltenden Zellstoffen

Procédé pour le blanchiment de pâte à papier chimiquement cuite contenant de la lignocellulose

(84) Designated Contracting States:
AT BE CH DE ES FR IT LI PT SE

(30) Priority: **29.10.1992 SE 9203200**

(43) Date of publication of application:
04.05.1994 Bulletin 1994/18

(73) Proprietor: **Eka Chemicals AB**
445 80 Bohus (SE)

(72) Inventors:
- **Holtinger, Lillemor**
  S-440 45 Nödinge (SE)
- **Hermansson, Wenche**
  S-446 00 Älvängen (SE)
- **Andersson, Lennart**
  S-433 61 Partille (SE)
- **Basta, Jiri**
  S-433 49 Partille (SE)
- **Linsten, Magnus**
  S-442 32 Kungälv (SE)

(74) Representative: **Schöld, Zaid**
Eka Chemicals AB
Patent Department
Box 11556
100 61 Stockholm (SE)

(56) References cited:

EP-A- 0 415 149	**EP-A- 0 480 469**
EP-A- 0 511 695	**US-A- 2 687 943**
US-A- 3 507 744	**US-A- 4 222 819**

- **DATABASE WPI Section Ch, Week 7727, Derwent Publications Ltd., London, GB; Class E33, AN 77-47879Y & JP-A-52 063 402 (MITSUBISHI GAS CHEM IND) 25 May 1977**
- **Tappi. vol. 51, n°1, January 1968, F.L. Fennel et al, "Hydrogen Peroxide for Bleaching Kraft Pulp", pp. 62A-66A**
- **R.P. Singh, The Bleaching of Pulp, 3rd Ed., revided, Tappi Press, 1979, pp. 642-643**
- **English translation of JP-A-52063402**

Printed by Jouve, 75001 PARIS (FR)

Description

[0001] The present invention relates to a process for bleaching of chemically digested lignocellulose-containing pulp, in which the pulp is treated at a pH between about 1 and about 7 in the presence of a magnesium compound, whereupon the pulp is washed and subsequently bleached with a peroxide-containing compound. The initial treatment removes from the pulp those trace metal ions that have a negative effect on the subsequent bleaching with a peroxide-containing compound. Owing to the presence of magnesium ions in dissolved form during the initial treatment, the magnesium ions are retained in those positions in the pulp where they have a particularly positive effect on the effectiveness of the bleaching stage.

Background of the Invention

[0002] In the making of lignocellulose-containing pulp of high brightness, the pulp is bleached in one or more stages. For quite some time, mechanical pulps have been bleached with chlorine-free bleaching agents, the intention in this case being to remove chromophoric groups while preserving the content of lignin. For environmental reasons, it has become increasingly common to treat also chemical pulps with chlorine-free bleaching agents, such as hydrogen peroxide, peracetic acid and ozone, already in the first bleaching stages. Unless the pulp is pretreated, however, bleaching with chlorine-free bleaching agents is less effective. Thus, hydrogen peroxide bleaching in alkaline environment is disturbed by the presence in the pulp of ions of certain trace metals, primarily Mn, Cu and Fe. These metal ions cause degradation of hydrogen peroxide into undesirable products, thereby reducing the effectiveness of the peroxide bleaching and increasing the consumption of peroxide.

[0003] The prior art teaches bleaching of chemical as well as mechanical pulps in the presence of magnesium salts. Most of the known bleaching processes do not comprise acid pretreatment, which preserves the content of undesirable trace metals in the pulp. Furthermore, bleaching with chlorine-free bleaching agents is normally performed in alkaline environment. As a result, it becomes impossible to retain or reintroduce the especially desirable magnesium ions, since these are precipitated at an alkaline pH and thus cannot diffuse into the pulp to such an extent that a pulp of high brightness and strength can be obtained.

[0004] US-A-2687943 refers to the bleaching of mechanical wood pulp with hydrogen peroxide the pulp being subjected to a calcium chloride pretreatment.

[0005] US-A-3507744 and JP-A-52063402 disclose the bleaching of high-yield pulps and chemical pulps with peroxide solutions where the pulps are subjected to alkaline earth metal pretreatments. However, non of the two documents teach an acidic pretreatment in the presence of a magnesium compound.

Description of the Invention

[0006] The invention provides a process for treating chemically digested lignocellulose-containing pulp under the conditions-disclosed in the claims, whereby the content of trace metal ions in the pulp is selectively aitered to render more effective the subsequent bleaching with a peroxide-containing compound.

[0007] Thus, the invention relates to a process for bleaching of chemically digested lignocellulose-containing pulp, whereby the pulp is treated with about 500 up to about 4000 ppm, based on dry pulp, of a magnesium compound in dissolved form at a pH within the range of from about 2 up to about 6, whereupon the pulp is washed wherein the pH of the washing liquid is equal to or higher than the pH of the treatment with the magnesium compound and subsequently the pulp is bleached with hydrogen peroxide at a pH in the range from 8 up to 12 in the presence of a calcium compound wherein the amount of calcium compound added in the bleaching is in the range from 100 ppm up to 4000 ppm, calculated as part by weight of alkaline earth metal on part by weight of dry pulp.

[0008] An initial acid treatment effectively removes metal ions from lignocellulose-containing pulps. However, magnesium ions, especially when in their original positions of the pulp, are known to have a positive influence on the selectivity of the bleaching and the consumption of peroxide-containing compounds. By the present process, undesirable metal ions are removed from the pulp suspension, while the magnesium ions are largely retained in their original positions. The latter is achieved by the presence of a magnesium compound in the treatment liquid, at such a pH and temperature that the compound is in dissolved form when contacted with the pulp. The present process further has the advantage of reducing the number of treatment stages compared with prior-art processes.

[0009] In the initial treatment, the magnesium compound should be in dissolved form when contacted with the pulp to produce a good effect. This can be achieved in various ways, depending, inter alia, on the type and properties of the pulp. The magnesium compound can be brought to dissolved form by a suitable choice of pH within the range of from about 1 up to about 7, in combination with a suitable temperature and concentration of the magnesium compound.

[0010] Besides a magnesium compound, the initial treatment may be carried out in the presence of at least one more compound containing an alkaline earth metal.

[0011] The magnesium-containing compound used is suitably magnesium sulphate, magnesium chloride, magnesium carbonate or magnesium nitrate, preferably magnesium sulphate. The calcium-containing compound used is suitably calcium chloride, calcium nitrate, calcium sulphate or calcium carbonate, preferably calcium chloride.

[0012] In the process according to the invention, the initial treatment is performed at a pH of from 2 up to 6, and preferably from 2 up to 5. The initial treatment may also be performed at a pH of from 3.1 up to 4.

[0013] In the initial treatment in the presence of a magnesium compound, the pH can be adjusted by adding an acid or an acid liquid to the pulp. The acid used may be an inorganic mineral acid or residual acid from a chlorine dioxide reactor, either separately or in optional mixture. Suitably, use is made of an inorganic mineral acid, such as sulphuric acid, nitric acid or hydrochloric acid, preferably sulphuric acid.

[0014] The amount of magnesium compound added in the initial treatment may be within the range of from about 500 ppm up to about 4000 ppm, calculated as part by weight of magnesium on part by weight of dry pulp. Suitably, the amount of the magnesium compound added lies within the range of from 500 ppm up to 3000 ppm, preferably within the range of from 500 ppm up to 2000 ppm.

[0015] The amount of an optional compound containing an alkaline earth metal added in the initial treatment may be within the range of from about 500 ppm up to about 4000 ppm, calculated as part by weight of alkaline earth metal on part by weight of dry pulp. Suitably, the amount of the compound containing an alkaline earth metal added lies within the range of from 500 ppm up to 3000 ppm, preferably within the range of from 500 ppm up to 2000 ppm.

[0016] The amount of magnesium compound added as well as the other conditions in the initial treatment are so chosen that the magnesium content of the pulp prior to the bleaching with a peroxide-containing compound amounts to at least about 50% of the initial content. Suitably, the amount of magnesium compound added as well as the other conditions are so chosen that the magnesium content of the pulp prior to the bleaching with a peroxide-containing compound lies within the range of from 100% up to 300% of the initial content, preferably within the range of from 130% up to 200%.

[0017] The peroxide-containing compound is hydrogen peroxide.

[0018] Bleaching with a peroxide-containing compound is suitably performed at a pH equal to or higher than the pH in the initial treatment in the presence of a magnesium compound. In this way, the trace metal ions having a positive effect on the bleaching are retained also in the bleaching stage itself. When the peroxide-containing compound is hydrogen peroxide, the pulp can be treated at a pH of from about 7 up to about 13, suitably at a pH of from 8 up to 12, preferably at a pH of from 9.5 up to 11. Bleaching with the other peroxide-containing compounds indicated above takes place within the normal pH ranges for each bleaching agent, which are well-known to the expert.

[0019] Bleaching with a peroxide-containing compound takes place in the presence of yet another compound containing a calcium compound. The compound containing an alkaline earth metal present in the bleaching, may be the same compound that was used in the initial treatment or another compound. The alkaline earth metal suitably is calcium, magnesium or barium, or a mixture thereof. This further improves the selectivity of the bleaching and reduces the consumption of the peroxide-containing compound. The bleaching takes place in the presence of a calcium compound. The calcium compound can be added to the pulp suspension outside the bleaching tower, e.g. by introduction into the pipeline leading to the bleaching tower. Also, the calcium compound can be added to the pulp suspension inside the bleaching tower, before the bleaching has commenced.

[0020] The amount of the compound containing an alkaline earth metal added in the bleaching, lies within the range of from about 100 ppm up to about 4000 ppm, calculated as part by weight of alkaline earth metal on part by weight of dry pulp. Suitably, the amount of the compound containing an alkaline earth metal added lies within the range of from 300 ppm up to 3000 ppm, preferably within the range of from 600 ppm up to 2000 ppm.

[0021] The calcium compound present in the bleaching with a peroxide-containing compound, is suitably calcium chloride, calcium nitrate, calcium sulphate or calcium carbonate. Calcium chloride is preferably used. Furthermore, the calcium compound is suitably added at such a combination of pH, temperature and concentration of the calcium compound that said compound is in active form when contacted with the pulp. Thus, suitably the pH lies within the range of from about 7 up to about 11. However, a positive effect is obtained also when the calcium compound is precipitated in the pulp suspension, e.g. as calcium carbonate.

[0022] The amount of calcium added as well as the other conditions in connection with the addition of calcium are so chosen that the calcium content of the pulp prior to the bleaching with a peroxide-containing compound amounts to at least about 25% of the calcium content prior to the initial treatment. At this, the pulp may be treated with calcium in the initial treatment as well as in the bleaching with a peroxide-containing compound. The amount of calcium compound added as well as the other conditions are suitably so chosen that the calcium content of the pulp prior to the bleaching with a peroxide-containing compound lies within the range of from 40% up to 150% of the original content, preferably within the range of from 50% up to 120% and most preferably within the'range of from 50% up to 70%.

[0023] The process according to the invention is performed with a washing stage after the initial treatment and before the bleaching with a peroxide-containing compound. Washing effectively removes those trace metal ions that have a negative effect on the subsequent bleaching with a peroxide-containing compound, e.g. ions of manganese, copper and iron. In order to retain the trace metal ions that have a positive effect on the subsequent bleaching with a peroxide-containing compound, primarily magnesium and calcium ions, the pH in the washing liquid is equal to or higher than the pH in the initial treatment. However, the pH in the washing liquid should lie within the range of from about 3 up to about 10, suitably within the range of from 5 up to 10. It is especially preferred that the pH in the washing liquid is at least about 2 pH units higher than the pH in the initial treatment.

[0024] The washing liquid may be fresh water, optionally containing some added pH-adjusting chemical, or wastewater from one or more bleaching stages or extraction stages, giving a suitable pH in the washing stage. Furthermore, the washing liquid may consist of other types of wastewater, optionally purified, provided that it has a low content of undesirable ions of metal, such as manganese, iron and copper.

[0025] Washing between the initial treatment and bleaching with a peroxide-containing compound relates to methods for removing, more or less completely, the liquid phase from the pulp suspension in order to reduce the content of dissolved trace metal ions in said suspension. Washing may involve raising the pulp concentration, e.g. by sucking-off or pressing the suspension through a filter, or lowering the pulp concentration, e.g. by dilution with a washing liquid. Washing also relates to combinations and sequences in which the pulp concentration is alternatingly raised and lowered, one or more times. In the present process, a washing method should be chosen which effectively removes the trace metal ions released in the initial treatment, aspects of process technique and economy being considered.

[0026] The effectiveness of the washing may be indicated as the amount of liquid phase removed, compared with the liquid phase present in the pulp suspension prior to washing. Washing effectiveness can be at least about 80%, and suitably lies within the range of from 90% up to 100%, preferably within the range of from 95% up to 100%.

[0027] The initial treatment in the presence of a magnesium compound can also be performed in the presence of a bleaching agent. Bleaching agents that are active within the pH range suitable for the initial treatment include chlorine dioxide, ozone and acid peroxide-containing compounds. Acid peroxide-containing compounds include such organic compounds as peracetic acid and such inorganic compounds as hydrogen peroxide and peroxosulphuric acid (Caro's acid). Suitably, the initial treatment takes place in the presence of ozone or peroxosulphuric acid, preferably ozone, since these bleaching agents affect but to a minor extent the content of ions of alkaline earth metals in the pulp.

[0028] The process according to the invention may also involve an extraction stage before the bleaching with a peroxide-containing compound. This is especially convenient when the initial treatment is performed in the presence of a bleaching agent. Suitably, the extraction is performed at a pH that is equal to or higher than the pH in the initial treatment. Suitably, the pH in the extraction stage lies within the range of from about 7 up to about 11, preferably within the range of from 8 up to 10.

[0029] Regardless of the number of stages or the type of treatment following the initial treatment, the pH in a subsequent stage suitably is equal to or higher than the pH in the preceding stage, in order to preserve the content of ions of alkaline earth metals in the pulp. In a sequence in which the pulp is first treated at a pH of about 2 in the presence of a magnesium compound and then washed and bleached with hydrogen peroxide, the pH in the washing stage should be at least about 4, and the pH in the bleaching stage should be at least about 8.

[0030] The term lignocellulose-containing pulp relates to pulps containing fibres that have been separated by chemical treatment, or recycled fibres. The fibres may be of hardwood or softwood. The term chemical pulp relates to pulps digested according to the sulphate, sulphite, soda or organo-solv process. The lignocellulose-containing pulp consists of chemically digested pulp, preferably sulphate pulp of softwood.

[0031] The process according to the invention, can be applied to pulps suitably with a yield within the range of from 40% up to 80%, preferably within the range of from 45% up to 65%.

[0032] The process according the invention, can be performed at an optional position in the bleaching sequence, e. g. immediately after the making of the pulp. When the process according to the invention is applied to a chemically digested pulp, this is preferably delignified in an oxygen stage before applying the process according to the invention.

[0033] The process according to the invention can be applied to chemically digested pulps having an initial kappa number within the range of from about 3 up to about 100, suitably from 4 up to 60, preferably from 5 up to 40. The kappa number is established according to the Standard Method SCAN-C 1:77.

[0034] In the process according to the invention, the initial treatment can be performed at a temperature of from about 10°C up to about 100°C, suitably from 25°C up to 90°C, preferably from 40°C up to 80°C. The initial treatment can be performed for a period of time of from about 1 s up to about 600 min, suitably from 1 min up to 120 min, preferably from 10 min up to 60 min. The pulp concentration in the initial treatment can be from about 1% by weight up to about 60% by weight, suitably from 2% by weight up to 40% by weight, preferably from 3% by weight up to 35% by weight.

[0035] When hydrogen peroxide is used as peroxide-containing compound, the pulp is treated at a temperature of from about 30°C up to about 100°C, preferably from 60°C up to 90°C, and for a period of time of from about 30 min up to about 960 min, suitably from 60 min up to 360 min. Further, when hydrogen peroxide is used as peroxide-containing compound, the pulp concentration can be from about 1% by weight up to about 70% by weight, suitably from 3% by weight up to 60% by weight, preferably from 10% by weight up to 50% by weight. Treatment with the other peroxide-containing compounds indicated above takes place within the normal ranges as to temperature, period of time and pulp concentration for each bleaching agent, which are well-known to the expert.

[0036] In preferred embodiments involving the use of hydrogen peroxide as peroxide-containing compound, the amount of hydrogen peroxide lies within the range of from about 1 kg up to about 60 kg per tonne of dry pulp, calculated as 100% hydrogen peroxide. The upper limit is not critical, but has been set for economic reasons. Suitably, the amount of hydrogen peroxide lies within the range of from 2 kg up to 50 kg per tonne of dry pulp, preferably from 5 kg up to 40 kg per tonne of dry pulp, calculated as 100% hydrogen peroxide.

[0037] After the initial treatment in the presence of magnesium and subsequent bleaching with a peroxide-containing compound, the pulp can be used as such for making paper of lower brightness. Alternatively, the pulp can be finally bleached to the desired higher brightness by treatment in one or more stages. Suitably, the final bleaching involves chlorine-free bleaching agents such as the peroxide-containing compounds indicated above, ozone, oxygen or sodium dithionite, optionally with intermediate alkaline extraction stages which may be reinforced with peroxide and/or oxygen. In this way, the formation and discharge of AOX is completely eliminated.

[0038] The invention and its advantages will be illustrated in more detail by the Examples below which however, are only intended to illustrate the invention without limiting the same. The percentages and parts stated in the description, claims and Examples, refer to percent by weight and parts by weight, respectively, unless otherwise stated. Furthermore, the pH values given in the description, claims and Examples refer to the pH at the end of each treatment, unless otherwise stated.

[0039] In the following Examples in which examples 1-4 are not according to the invention, the kappa number, viscosity and brightness of the pulp were established according to SCAN Standard Methods, and the consumption of hydrogen peroxide was determined by iodometric titration.

Example 1

[0040] Oxygen-delignified sulphate pulp of softwood having a kappa number of 18, a brightness of 34.2% ISO and a viscosity of 1000 dm^3/kg was treated at a pH of 2.1 +/-0.1 in the presence of various alkaline earth metals. After oxygen delignification, the sulphate pulp had a pH of about 11, which was adjusted by an addition of 15 kg sulphuric acid/tonne dry pulp. The amount of alkaline earth metal added was 1000 ppm, calculated as part by weight of each alkaline earth metal on part by weight of dry pulp. In the initial treatment, the temperature was 50°C, the treatment time was 30 min and the pulp concentration was 10% by weight. In the initial treatment, the general conditions as well as the compound containing an alkaline earth metal were so chosen that the alkaline earth metal present was dissolved in the pulp suspension. After the initial treatment, the pulp was washed at a pH of 6-7, in order to remove those metal ions that have a negative effect on the subsequent chlorine-free bleaching. Subsequently, the pulp was bleached with hydrogen peroxide at a temperature of 90°C, a residence time of 240 min, and a pulp concentration of 10% by weight. The addition of hydrogen peroxide was 25 kg/tonne dry pulp, calculated as 100% hydrogen peroxide, and the pH was about 10.5. For comparative purposes, the pulp was treated without addition of an alkaline earth metal, and subsequently bleached with hydrogen peroxide under the conditions stated above (Test 4). For further comparison, the pulp was treated with magnesium as in Test 1, but without an intermediate washing stage (Test 5). The results of the tests appear from Table I below.

TABLE I

Test	Alkaline earth metal	Pulp properties after peroxide bleaching		
		Kappa number	Viscosity (dm^3/kg)	Brightness (% ISO)
1	Mg	9.2	830	63.4
2	Ca	10.5	800	53.0
3	Ba	11.4	880	51.0
4	--- *	12.8	840	45.5
5	Mg **	12.2	880	41.0

* No alkaline earth metal added.

** No washing stage after the magnesium treatment.

[0041] As is evident from the Table, pulp treatment according to the invention at a pH of about 2.1 in the presence of a magnesium compound, results in a much higher increase in brightness and a more substantial reduction of the kappa number than does a treatment in the absence of such a compound.

Example 2

[0042] The oxygen-delignified sulphate pulp of softwood employed in Example 1 was treated in the presence of a magnesium compound at a pH within the range of from 1.5 up to 11 in order to illustrate the effect of pH in the initial treatment. The amount of magnesium added was 1000 ppm, calculated as part by weight of magnesium on part by weight of dry pulp. The conditions in the initial treatment were identical with those in Example 1, except the pH variation. Likewise, the conditions in the subsequent hydrogen peroxide bleaching were identical with those in Example 1. After the initial treatment, the pulp was washed at a pH that was about 2 pH units higher than that in the initial treatment. The results of the tests appear from Table II below.

TABLE II

Test	pH in the initial treatment	Pulp properties after peroxide bleaching		
		Kappa number	Viscosity (dm^3/kg)	Brightness (% ISO)
1	1.5	9.1	795	64.0
2	2.0	9.2	835	63.2
3	3.3	9.6	820	61.0
4	4.4	9.7	815	60.2
5	6.1	9.9	825	59.3
6	6.8	10.2	840	57.5
7	10.8	12.1	880	43.6

[0043] As is evident from the Table, pulp treatment according to the invention at a pH within the range of from about 1 up to about 7, results in a much higher increase in brightness and a more substantial reduction of the kappa number than does treatment at a pH above this range.

Example 3

[0044] The oxygen-delignified sulphate pulp of softwood employed in Example 1 was treated in the presence of a magnesium compound at a pH of 2.1 +/- 0.1 in order to illustrate the effect of pH in the subsequent washing stage. In the initial treatment, the pH was adjusted by addition of sulphuric acid. The amount of magnesium added was 1000 ppm, calculated as part by weight of magnesium on part by weight of dry pulp. The conditions in the initial treatment as well as in the hydrogen peroxide bleaching were identical with those in Example 1. After the initial treatment, the pulp was washed at a pH within the range of from 3 up to about 11 where appropriate by deionised water to which sodium hydroxide had been added. The results of the tests appear from Table III below.

TABLE III

Test	pH in the washing stage	Pulp properties after peroxide bleaching		
		Kappa number	Viscosity (dm^3/kg)	Brightness (% ISO)
1	3.0	11.9	890	52.9
2	4.3	10.2	830	58.9
3	4.8	10.2	840	59.4
4	6.9	9.0	835	63.4
5	8.2	9.0	830	64.0
6	10.8	9.0	800	59.5

[0045] As is evident from the Table, pulp treatment according to the invention with an intermediate washing stage at a pH within the range of from about 3 up to about 10 results in a considerable increase in brightness and a considerable reduction of the kappa number.

Example 4

[0046] The oxygen-delignified sulphate pulp of softwood employed in Example 1 was treated in the presence of a magnesium compound at a pH of 2.1 +/- 0.1 in order to illustrate the effect of pH in the bleaching with hydrogen peroxide within the range of from 7 up to 12. The amount of magnesium added was 1000 ppm, calculated as part by weight of magnesium on part by weight of dry pulp. The conditions in the initial treatment were identical with those in Example 1, as were the conditions in the hydrogen peroxide bleaching, except the pH variation. After the initial treatment, the pulp was washed at a pH of 6-7. The results of the tests appear from Table IV below.

TABLE IV

Test	pH in the bleaching stage	Pulp properties after peroxide bleaching		
		Kappa number	Viscosity (dm^3/kg)	Brightness (% ISO)
1	7.1	12.0	900	50.2
2	8.2	9.9	830	58.0
3	10.3	9.2	825	63.1
4	11.9	9.1	780	62.5

[0047] As is evident from the Table, pulp treatment according to the present invention using hydrogen peroxide as the peroxide-containing compound, results in a very high increase in brightness and a considerable reduction of the kappa number.

Example 5

[0048] The oxygen-delignified sulphate pulp of softwood employed in Example 1 was treated in the presence of a magnesium compound at a pH of 2.1 +/-0.1 in order to illustrate the effect of a calcium compound on the hydrogen peroxide bleaching (Test 2). The amount of magnesium added was 1000 ppm, calculated as part by weight of magnesium on part by weight of dry pulp. After washing, calcium was added in an amount of 1000 ppm, calculated as part by weight of calcium on part by weight of dry pulp. The conditions in the initial treatment were identical with those in Example 1, as were the conditions in the hydrogen peroxide bleaching, except the presence of a calcium compound. After the initial treatment, the pulp was washed at a pH of 6-7. For comparative purposes, the pulp was also bleached in the absence of the calcium compound (Test 1). The results of the tests appear from Table V below.

TABLE V

Test	Pulp properties after peroxide bleaching			Remaining H_2O_2 (kg/tonne)
	Kappa number	Viscosity (dm^3/kg)	Brightness (% ISO)	
1	9.2	830	63.1	0
2	8.9	850	68.2	3.1

[0049] As is evident from the Table, pulp treatment according to the invention using a calcium compound in the hydrogen peroxide bleaching, results in a much higher brightness at a lower consumption of hydrogen peroxide than does bleaching in the absence of calcium.

Example 6

[0050] The oxygen-delignified sulphate pulp of softwood employed in Example 1 was treated in the presence of a magnesium compound at a pH of 2.1 +/- 0.1, washed and bleached with hydrogen peroxide, in order to illustrate the effect of a selective metal profile in the pulp prior to bleaching. The amount of magnesium added was 1000 ppm, calculated as part by weight of magnesium on part by weight of dry pulp. After washing, calcium was added in an amount of 1000 ppm, calculated as part by weight of calcium on part by weight of dry pulp (Test 4). The conditions in the initial treatment were identical with those in Example 1, as were the conditions in the hydrogen peroxide bleaching, except the presence of calcium compound in Test 4. After the initial treatment, the pulp was washed at a pH of about 3 (Test 1) and 6-7 (Tests 2-4), respectively. For comparative purposes, the pulp was treated without any magnesium in the initial treatment and without any calcium in the bleaching stage (Tests 1 and 2). The content of certain metal ions in the sulphate pulp before (test 0) and after the initial treatment, as well as the brightness after the hydrogen peroxide bleaching, appear from Table VI below.

TABLE VI

Test	Metal content before bleaching, ppm					Brightness after bleaching (%ISO)
	Mg	Ca	Mn	Fe	Cu	
0	300	1800	68	8.3	1.5	----
1	30	220	6.5	5.8	< 0.5	45.5
2	100	640	20	7.0	0.9	45.7
3	550	690	18	6.3	0.7	63.2
4	550	1700	18	6.3	0.7	68.2

[0051] As is evident from the Table, the process according to the invention involving treatment in the presence of a magnesium compound, followed by hydrogen peroxide bleaching, results in a much higher brightness at a lower consumption of hydrogen peroxide than does bleaching in the absence of calcium.

Claims

1. A process for bleaching of chemically digested lignocellulose-containing pulp, **characterised in that** the pulp is treated with about 500 up to about 4000 ppm, based on dry pulp, of a magnesium compound in dissolved form at a pH within the range of from about 2 up to about 6, whereupon the pulp is washed, wherein the pH of the washing liquid is equal to or higher than the pH of the treatment with a magnesium compound, and subsequently the pulp is bleached with hydrogen peroxide at a pH in the range from about 8 up to 12 in the presence of a calcium compound wherein the amount of calcium compound added in the bleaching is in the range from 100 ppm up to 4000 ppm, calculated as part by weight of alkaline earth metal on part by weight of dry pulp.

2. A process according to any of the preceding claims, **characterised in that** a bleaching agent is present at the treatment with a magnesium compound.

3. A process according to any of the preceding claims, **characterized in that** the magnesium content of the pulp after treatment with a magnesium compound and subsequent washing, and prior to the bleaching with hydrogen peroxide lies within the range of from 100% up to 300% of the initial content.

Patentansprüche

1. Verfahren zum Bleichen von chemisch aufgeschlossenem lignocellulosehaltigem Faserbrei, **dadurch gekennzeichnet, daß** der Faserbrei bei einem pH-Wert im Bereich von etwa 2 bis etwa 6 mit etwa 500 bis etwa 4000 ppm, bezogen auf trockenen Faserbrei, einer Magnesiumverbindung in gelöster Form behandelt wird, worauf der Faserbrei gewaschen wird, wobei der pH-Wert der Waschflüssigkeit gleich dem pH-Wert der Behandlung mit der Magnesiumverbindung ist oder höher, und daß anschließend der Faserbrei mit Wasserstoffperoxid bei einem pH-Wert im Bereich von etwa 8 bis etwa 12 in Gegenwart einer Calciumverbindung gebleicht wird, wobei die Menge an Calciumverbindung, die beim Bleichen zugegeben wird, im Bereich von 100 bis 4000 ppm liegt, berechnet als Gewichtsteil von Erdalkalimetall bezogen auf Gewichtsteil trockener Faserbrei.

2. Verfahren gemäß dem vorstehenden Anspruch, **dadurch gekennzeichnet, daß** bei der Behandlung mit der Magnesiumverbindung ein Bleichmittel vorhanden ist.

3. Verfahren nach einem der vorstehenden Ansprüche, **dadurch gekennzeichnet, daß** der Magnesiumgehalt des Faserbreis nach der Behandlung mit der Magnesiumverbindung und dem anschließenden Waschen und vor dem Bleichen mit Wasserstoffperoxid im Bereich von 100 % bis 300 % des anfänglichen Gehaltes liegt.

Revendications

1. Procédé pour blanchir une pâte contenant de la lignocellulose chimiquement digérée, **caractérisé en ce que** l'on traite la pâte avec environ 500 jusqu'à environ 4000 ppm, par rapport à la pâte sèche, d'un composé de magnésium sous forme dissoute, à un pH se situant dans l'intervalle allant d'environ 2 à environ 6, après quoi on lave la pâte, le pH du liquide de lavage étant supérieur ou égal au pH du traitement avec un composé de magnésium, puis on blanchit la pâte avec du peroxyde d'hydrogène à un pH se situant dans l'intervalle allant d'environ 8 à 12, en présence d'un composé de calcium, la quantité de composé de calcium ajouté dans le blanchiment se situant dans l'intervalle allant de 100 ppm à 4000ppm, calculée en parties en poids de métal alcalino-terreux par rapport aux parties en poids de pâte sèche.

2. Procédé selon l'une quelconque des revendications précédentes, **caractérisé en ce qu'**un agent de blanchiment est présent lors du traitement avec un composé de magnésium.

3. Procédé selon l'une quelconque des revendications précédentes, **caractérisé en ce que** la teneur en magnésium de la pâte après traitement avec un composé de magnésium et lavage ultérieur, et avant le blanchiment avec du peroxyde d'hydrogène se situe dans l'intervalle allant de 100 % à 300 % de la teneur initiale.