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(12) (19) (CA) **Brevet-Patent**

(11) (21) (C) **2,103,066**

(86) 1992/05/12
(87) 1992/11/26
(45) 2001/04/24

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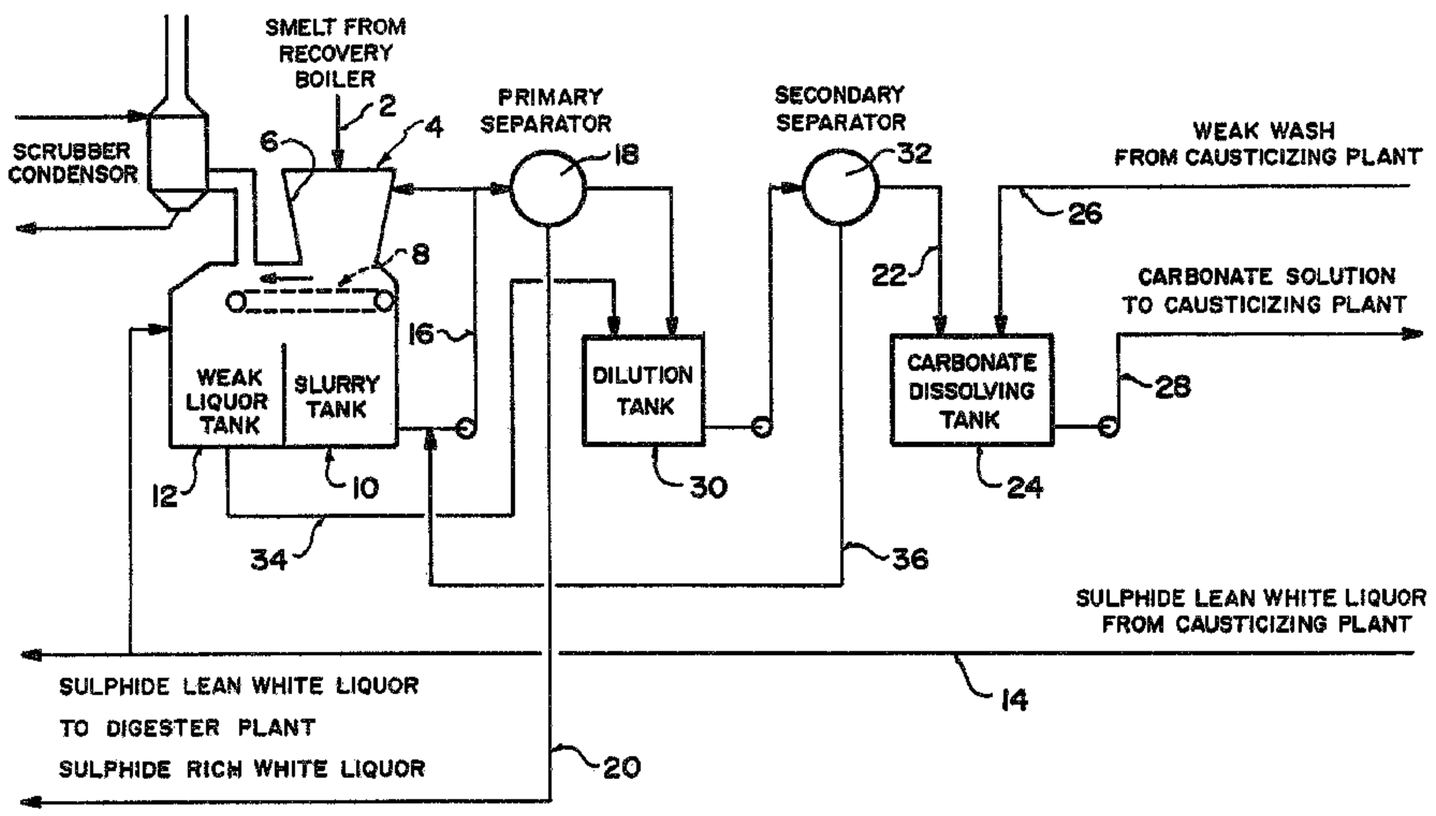
(51) Int.Cl.[5] D21C 3/02, D21C 3/24, D21C 11/00
(30) 1991/05/13 (699,687) US

(54) **PREPARATION DE LIQUEUR BLANCHE ET PROCEDE DE REDUCTION DU BOIS EN PATE**

(54) **WHITE LIQUOR PREPARATION AND PULPING PROCESS**



(57) Elaboration de liqueur blanche en flux à faible teneur en sulfure et en flux à forte teneur en sulfure, permettant d'obtenir une efficacité accrue du processus de digestion de la pâte kraft dans un procédé tel que le procédé Kamyr de cuisson continue modifié. L'amélioration consiste, dans le cadre d'un procédé de réduction en pâte kraft comportant plusieurs phases de délignification de matières cellulosiques ligneuses et mettant en oeuvre des charges de liqueur blanche divisée, de produire un flux de liqueur blanche à faible teneur en sulfure et un flux de liqueur blanche à forte teneur en sulfure par lessivage des solides d'une chaudière de récupération dissous (2) dans l'eau ou dans une liqueur blanche à faible teneur en sulfure, renfermant moins de 15 % en poids d'hydroxyde de sodium, afin d'obtenir une liqueur blanche (20) à forte teneur en sulfure renfermant du sulfure de sodium et de de l'hydroxyde de sodium en solution aqueuse et des particules solides renfermant du carbonate de sodium. Les particules solides sont séparées de la liqueur blanche à forte teneur en sulfure, le contenu en carbonate de

(57) This invention relates to producing white liquor in a sulphide-lean stream and a sulphide-rich stream to obtain improved efficiencies in a kraft pulp digesting process such as the Kamyr modified continuous cooking process. In a kraft pulping process including multiple phases of delignification of lignocellulosic materials and utilizing split white liquor charges the improvement comprising producing a sulphide-lean white liquor stream and a sulphide-rich white liquor stream by leaching solids of a recovery boiler smelt (2) with water or sulphide-lean white liquor with a sodium hydroxide content less than 15 % by weight, to obtain a sulphide-rich white liquor (20) comprising sodium sulphide and sodium hydroxide in aqueous solution and solid particles comprising sodium carbonate, separating the solid particles from the sulphide-rich white liquor, dissolving the sodium carbonate content of the solid particles in water or a weak wash from a causticizing plant to form a sodium carbonate solution (28), causticizing the sodium carbonate solution to a sulphide-lean white liquor (14) in a causticizing plant, and recycling at least part of the

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sodium est dissous des particules solides en suspension dans l'eau ou dans une élutriation légère provenant d'un installation de caustification, pour obtenir une solution de carbonate de sodium (28), la solution de carbonate de sodium est caustifiée par une liqueur blanche à faible teneur en sulfure (14) dans une installation de caustification et l'on recycle - du moins en partie - la liqueur blanche à forte teneur en sulfure dans un stade initial du processus de réduction en pâte.

sulphide-rich white liquor to an initial phase of the pulping process.

PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 5 : D21C 3/02, 3/24, 11/00

A1

(11) International Publication Number: WO 92/20856

(43) International Publication Date: 26 November 1992 (26.11.92)

2103066

(21) International Application Number: PCT/CA92/00212

(22) International Filing Date: 12 May 1992 (12.05.92)

(30) Priority data:
699,687 13 May 1991 (13.05.91) US

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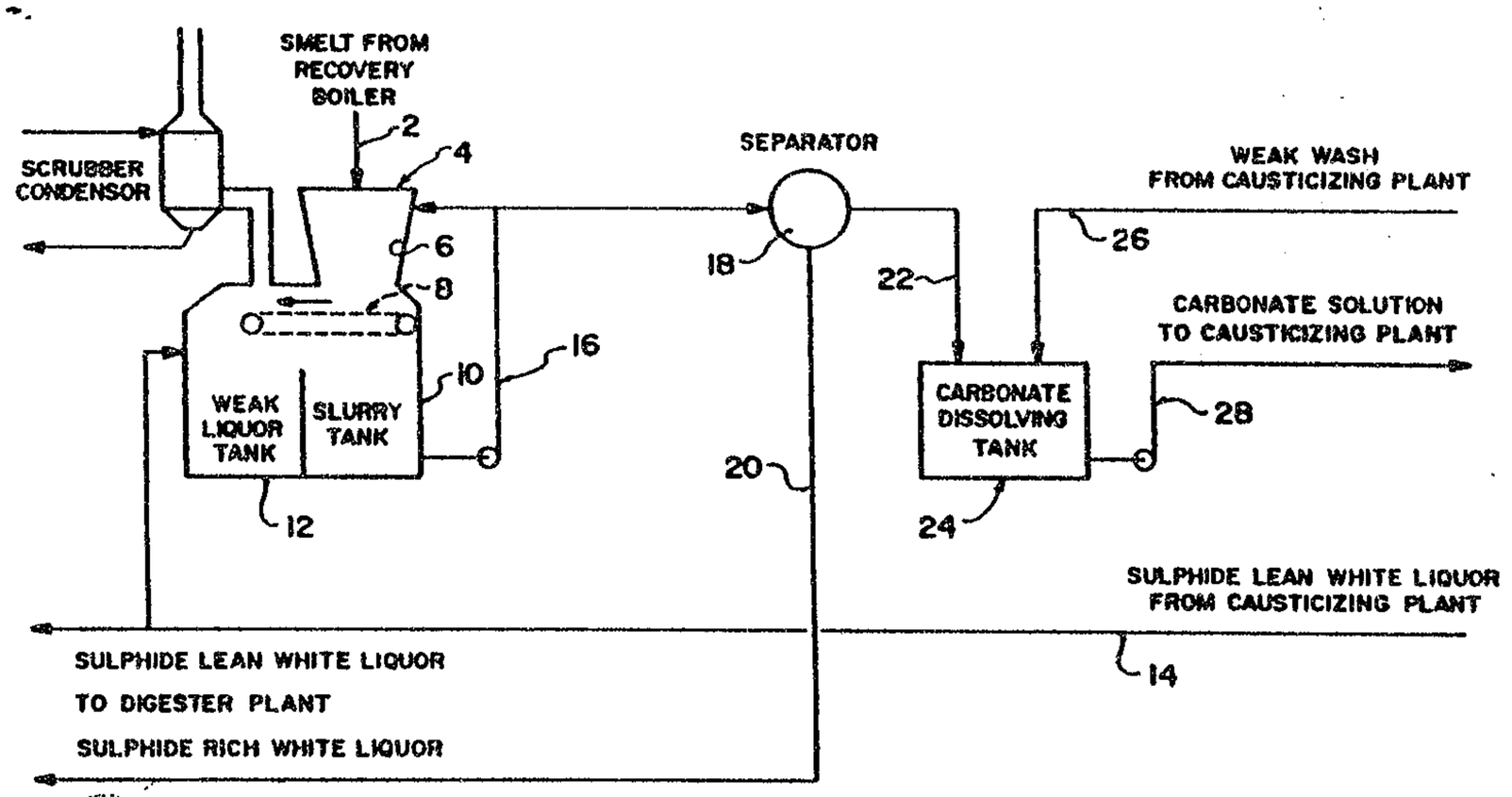
(81) Designated States: AT, AT (European patent), AU, BB, BE (European patent), BF (OAPI patent), BG, BJ (OAPI patent), BR, CA, CF (OAPI patent), CG (OAPI patent), CH, CH (European patent), CI (OAPI patent), CM (OAPI patent), CS, DE, DE (European patent), DK, DK (European patent), ES, ES (European patent), FI, FR (European patent), GA (OAPI patent), GB, GB (European patent), GN (OAPI patent), GR (European patent), HU, IT (European patent), JP, KP, KR, LK, LU, LU (European patent), MC (European patent), MG, ML (OAPI patent), MN, MR (OAPI patent), MW, NL, NL (European patent), NO, PL, RO, RU, SD, SE, SE (European patent), SN (OAPI patent), TD (OAPI patent), TG (OAPI patent), US.

Published
With international search report.
With amended claims.

Date of publication of the amended claims:
23 December 1992 (23.12.92)

(54) Title: WHITE LIQUOR PREPARATION AND PULPING PROCESS



(57) Abstract

This invention relates to producing white liquor in a sulphide-lean stream and a sulphide-rich stream to obtain improved efficiencies in a kraft pulp digesting process such as the Kamyr modified continuous cooking process. In a kraft pulping process including multiple phases of delignification of lignocellulosic materials and utilizing split white liquor charges the improvement comprising producing a sulphide-lean white liquor stream and a sulphide-rich white liquor stream by leaching solids of a recovery boiler smelt (2) with water or sulphide-lean white liquor with a sodium hydroxide content less than 15 % by weight, to obtain a sulphide-rich white liquor (20) comprising sodium sulphide and sodium hydroxide in aqueous solution and solid particles comprising sodium carbonate, separating the solid particles from the sulphide-rich white liquor, dissolving the sodium carbonate content of the solid particles in water or a weak wash from a causticizing plant to form a sodium carbonate solution (28), causticizing the sodium carbonate solution to a sulphide-lean white liquor (14) in a causticizing plant, and recycling at least part of the sulphide-rich white liquor to an initial phase of the pulping process.

WHITE LIQUOR PREPARATION AND PULPING PROCESS

FIELD OF THE INVENTION

This invention pertains to a novel process for producing white liquor in separate streams to obtain higher efficiencies in a kraft pulp digesting reactor.

BACKGROUND OF THE INVENTION

In conventional pulping operations, the raw cellulosic fibrous material, generally wood chips, is digested in a pulping liqour, generally known as a "white liquor". This latter term is used in this specification generally to refer to liquors containing dissolved sodium hydroxide. After the digestion step, the pulp is separated from spent pulping liquor, known as "black liquor".

In the normal kraft process, the cellulosic fibrous material, generally wood chips, is digested by heating with a white liquor containing sodium sulphide and sodium hydroxide to dissolve from the wood chips a substantial part of the hemicelluloses and lignin therein. The fibrous material so produced is separated from the resulting black liquor, by washing counter-current with water in a brown stock washing plant and, thereafter, may be passed to a bleaching process.

The black liquor is subjected to a series of operations in a recovery system. The black liquor first is concentrated by evaporation of water and the concentrated black liquor is burned in a furnace to yield a smelt containing mainly sodium carbonate and sodium sulphide. The smelt is dissolved in water to yield a raw green liquor which then is clarified. The dregs resulting from the clarification, generally consisting of insoluble salts of metal cations other than sodium and potassium, and of clear residues, are washed with water and discarded.

The clarified green liquor is causticized with slaked lime whereby the sodium carbonate is converted to sodium hydroxide and calcium carbonate is precipitated as a mud. The mud is washed with water and calcined to regenerate lime for further causticization. The causticized green liquor is then recycled as white liquor to the digester. The wash water from the dregs and the mud is usually used as water for dissolving the smelt.

Sulphur and sodium containing by-products from chlorine dioxide generation, purchased sodium sulphate, and elemental sulphur and/or sodium hydroxide or soda ash, are added to the recovery operation to provide make-up sodium and sulphur values to the system. Generally the sodium sulphate is added to the black liquor before it is fed to the furnace. The sodium and sulphur values in the furnace give sodium sulphide and sodium carbonate, the sodium carbonate being converted to sodium hydroxide on later causticization. In this manner, the sodium hydroxide and sodium sulphide content of the white liquor is maintained at the desired level.

During the past decade, and because of environmental concerns, considerable effort has been invested in improving the efficiencies of traditional pulp and paper manufacturing facilities in North America, and elsewhere, and minimizing the discharge of pollutants from such mills. In recent years, kraft pulp digesting processes employing what is commonly known as a modified continuous cooking (MCC™) process have become popular. A digester system known as the Kamyr modified continuous cooking process digester system has been widely installed in pulp and paper manufacturing facilities throughout the world.

In a conventional pulping process, the lignin in the pulp must be separated from the cellulose and hemicellulose. However, in the process, the delignification

reaction must be emphasized while the cellulose and hemicellulose degradation reactions must be minimized. Degraded cellulose and hemicellulose reduce the inherent strength qualities of the pulp for paper making. It is therefore important in a pulping process to obtain high selectivity. The term "high selectivity" in a pulping process means that the rate of the delignification reaction is high compared to the reactions that degrade cellulose and hemicellulose. High selectivity in pulping makes it possible to produce a pulp with low residual lignin content prior to bleaching while maintaining good pulp strength by minimizing cellulose and hemicellulose degradation. By minimizing the lignin content of the pulp entering the bleach plant, less lignin has to be removed through the bleaching process, thus reducing bleach chemicals consumption and the contaminant content of the bleach plant effluent.

In the Kamyr modified continuous cooking (MCC) pulping process, the selectivity of the process compared to a conventional process has been improved by keeping the hydroxide concentration moderate and even throughout the cook, and keeping the dissolved lignin and sodium concentration as low as possible, which is especially important during the final phase of the cook.

In the MCC process, the alkali charge is generally divided into three portions, one to the impregnation vessel, one to the trim circulation and one to the final part of the cook. In this manner, the hydroxide concentration is evened out throughout the process. Further, the final phase of the cook is carried out in countercurrent mode to lower the dissolved lignin concentration during this phase. In certain recent Kamyr MCC installations, a four-way split of the white liquor charge is made, with the three portions applied as discussed, and the fourth portion applied to the wash zone recirculation. However, the

triple or quadruple divided alkali charge also has an undesired consequence - it lowers the hydrosulphide concentration during the initial and bulk delignification phases as part of the white liquor is charged to the latter portion of the cook where sulphide content does not have any beneficial effect.

One way to improve the selectivity of the modified Kamyr modified continuous cooking (MCC) process or other extended delignification processes is to increase the hydro-sulphide concentration in the initial and bulk delignification phases of the cook by modifying the white liquor preparation process.

SUMMARY OF THE INVENTION

The invention is directed to a kraft digesting process which utilizes white liquor in a novel way. The white liquor is prepared into a sulphide-lean stream and a sulphide-rich stream. The sulphide-rich stream is directed to the initial phase or the first two phases of the digestion process, to improve process efficiency.

In a kraft pulping process including multiple phases of delignification of lignocellulosic materials and utilizing split white liquor charges the improvement comprising producing a sulphide-lean white liquor stream and a sulphide-rich white liquor stream by leaching solids of a recovery boiler smelt with water or sulphide-lean white liquor with a sodium hydroxide content less than 15% by weight, to obtain a sulphide-rich white liquor comprising sodium sulphide and sodium hydroxide in aqueous solution and solid particles comprising sodium carbonate, separating the solid particles from the sulphide-rich white liquor, dissolving the sodium carbonate content of the solid particles in water or a weak wash from a causticizing plant to form a sodium carbonate solution, causticizing the

sodium carbonate solution to a sulphide-lean white liquor in a causticizing plant, and recycling at least part of the sulphide-rich white liquor to an initial phase of the pulping process.

Excess sulphide-rich white liquor from the initial phase can be directed to the beginning of the bulk delignification phase. The sulphide-lean white liquor can be obtained from causticizing carbonate content in the smelt, and using the liquor for recovery boiler smelt leaching.

A portion of the sulphide-rich liquor, the solid sodium carbonate, the carbonate solution and the sulphide-lean white liquor can be used in other pulping processes, pulp oxygen delignification plants, pulp bleaching plants or flue gas scrubbing processes. The sodium carbonate can be purified to produce a material with a low sulphide content. The sodium carbonate can be purified by washing.

The invention is directed to a process of generating a sulphide-rich white liquor and a sulphide-lean white liquor which comprises: (a) introducing smelt from a recovery boiler into a smelt hopper, said smelt containing molten sodium sulphide and sodium carbonate; (b) flushing the smelt with a liquid whereby the smelt is dispersed and solidified into particles; (c) separating the particles into small and large particles and passing the small particles into a slurry tank where sodium sulphide is preferentially dissolved from the particles; (d) passing the large particles into a weak liquor tank and dissolving the coarse particles therein; (e) adding a sulphide-lean white liquor obtained from a causticizing plant to the weak liquor tank; (f) separating the contents of the slurry tank into a sulphide-rich white liquor containing sodium sulphide and sodium hydroxide, and a solid containing sodium carbonate; (g) dissolving the solid containing sodium

carbonate in a weak wash obtained from the causticizing plant in order to generate a sulphide-lean white liquor; and (h) recycling the sulphide-rich white liquor stream to an initial phase of the digestion process.

The sulphide-lean white liquor can be washed to produce a slurry with a low sulphide content. Excess sulphide-rich white liquor from the initial phase can be directed to the beginning of a bulk delignification phase in the process.

The invention is also directed to a kraft pulping process comprising: (a) delignifying lignocellulosic material in at least an initial delignification phase and a bulk delignification phase; (b) producing a sulphide-rich white liquor stream; (c) producing a sulphide-lean white liquor stream; and (d) cycling at least a part of the sulphide-rich white liquor to the initial delignification phase.

Excess sulphide-rich white liquor can be directed to the beginning of the bulk delignification phase. The sulphide-rich white liquor can be obtained by leaching solids of a recovery boiler smelt. The sulphide-lean white liquor can be obtained by causticizing a sodium carbonate solution. A major portion of the sulphide-rich liquor can be applied to a second co-current liquor charge which is made at the beginning of the bulk delignification phase.

DRAWINGS

Figure 1 illustrates a block diagram of a smelt leaching process without slurry washing; and

Figure 2 illustrates a block diagram of a smelt leaching process with slurry washing.

DETAILED DESCRIPTION OF SPECIFIC EMBODIMENTS OF THE INVENTION

Referring to Figure 1, which illustrates a block diagram of a smelt leaching process without slurry washing, the smelt 2 from the recovery boiler mainly consisting of molten sodium sulphide (Na_2S) and sodium carbonate (Na_2CO_3) enters a smelt hopper 4, where it comes in contact with a slurry that continuously flushes the hopper walls 6. Through this contact, the smelt 2 is dispersed and solidified into small particles. These small particles pass through a smelt screen 8 into the slurry tank 10 where sodium sulphide is preferentially dissolved from the particles. Any coarse particles not passing through the smelt screen 8 are discharged into a weak liquor tank 12 where they are dissolved.

This part of the system utilizes the technology developed by Ebara (Mizuguichi, S. and Naito, T., "NSSC recovery process uses direct oxidation", Pulp & Paper Canada, 79:8, p. T251-253, 1978; and Teder, A., "Japansk metod foradlar sodahussmalta" ("Japanese method processes recovery boiler smelt"), In Swedish, Nordisk Cellulosa Nr. 2, p. 12-14, 1984) for the NSSC recovery, but modifies the technology to avoid oxidation of sulphide and to utilize the heat content of the smelt to evaporate water from the liquor. These modifications include operating the system under boiling conditions instead of cooling with coils in the slurry bank and closing of the tanks to avoid air infiltration.

Sulphide-lean white liquor from the causticizing plant 14 is continuously added to the weak liquor tank 12 and liquor overflows from this tank to maintain the level in the slurry tank 10.

Slurry 16 from the slurry tank 10, mainly consisting of solid sodium carbonate in a solution of sodium sulphide and sodium hydroxide, is separated in a separator 18 into a sulphide-rich white liquor 20 of extremely high causticity (low carbonate content) and a high concentration of sodium hydroxide and sodium sulfide, and a cake 22 consisting mainly of sodium carbonate.

The solid sodium carbonate is dissolved in a carbonate dissolving tank 24 in weak wash 26 from a causticizing plant. The resulting carbonate solution 28 is then sent to a causticizing plant and is causticized in a conventional manner to a sulphide-lean white liquor 14.

Optionally, if a sulphide-lean white liquor or carbonate solution with a very low sulphide content is required (i.e. for use in flue gas scrubbing) a washing stage can be included. An example of such an arrangement is shown in Figure 2, which represents a block diagram of a smelt leaching process with slurry washing.

The process illustrated in Figure 2 is similar to that shown in Figure 1. However, a dilution tank 30 and a secondary separator 32 are included. Some weak liquor from weak liquor tank 12 is transported through line 34 to the dilution tank 30. A slurry from secondary separator 32 is cycled by line 36 to the slurry in line 16 from slurry tank 10.

Process Operating Conditions

To promote high selectivity in the kraft pulping process, the following main guidelines should be followed:

1. The hydroxide concentration should be kept moderate and consistent throughout the cook;

2. The dissolved lignin and sodium concentration should be kept as low as possible. This is especially important during the final phase of the cook.

3. The hydrosulphide concentration during the initial and bulk delignification phases of the cook should be as high as possible.

A typical MCC process focuses on the first two main rules. However, the process of the invention enables the hydrosulphide concentration during the initial and bulk delignification phases of the cook to remain as high as possible.

At a 35% average white liquor sulphidity, the average overall liquor concentration increases by about 60%, giving lower steam consumption in the digester and evaporation plants and decreasing evaporator capacity requirement. The process of the invention decreases the hydraulic load on the causticizing plant by 20% to 30%. The process of the invention also provides an opportunity to improve total white liquor causticity, that is, to lower the content of inactive sodium carbonate in the white liquor.

In contrast to a conventional white liquor evaporation process, the process of the invention does not require any steam since the process is driven by the concentration and temperature difference between the smelt and the white liquor.

Most steps of the process can readily utilize established technology from the Ebara recovery process and from the soda ash industry. Further, the process makes available sulphide-lean carbonate and white liquor for use in applications such as flue gas scrubbing, neutral sul-

phite semi-chemical (NSSC) pulping, oxygen delignification plants and bleach plant extraction stages, and general pH control.

Also, part of the sulphide-rich white liquor stream can find application in processes such as yield improving hydrosulphide pretreatment, and sulphite liquor preparation systems.

White Liquor Preparation -
Conventional Reference Case

Smelt from a kraft process recovery boiler is processed through a conventional white liquor preparation process to yield a product white liquor as tabulated in Table 1:

Table 1

	Smelt	White Liquor
Water (kg)	0.0	1639.5
Sodium Carbonate (kg)	231.6	38.2
Sodium sulphide (kg)	76.6	76.6
Sodium sulphate (kg)	7.3	7.3
Sodium hydroxide (kg)	0.0	145.8
Insoluble inerts (kg)	3.6	0.04
Effective alkali (as kg NaOH)	--	185.0
(as kg Na_2O)	--	143.4
Sulphidity (% on active alkali)	--	35.0

White Liquor Preparation

The same process recovery boiler smelt as for the reference case is used in the smelt separation process of this invention but it is converted to a sulphide-rich white liquor and a sulphide-lean white liquor with compositions as shown in Table 2.

Table 2

Component	Smelt	White Liquor	
		Sulphide-Rich	Sulphide-Lean
Water (kg)	0.0	316.5	712.5
Sodium carbonate (kg)	231.6	~0	26.3
Sodium sulphide (kg)	76.6	72.3	4.3
Sodium sulphate (kg)	7.3	~0	7.3
Sodium hydroxide (kg)	0.0	61.5	93.0
Insoluble inerts (kg)	3.6	~0	0.02
Effective alkali (as NaOH kg)	N/A	98.6	95.2
(as Na_2O kg)	N/A	76.4	73.8
Sulphidity (% on active alkali)	N/A	54.7	4.5

The medium used for smelt leaching is a part of the sulphide-lean white liquor. The combined concentration of dissolved sodium sulphide and sodium hydroxide in the smelt leaching step is held at 30% of the weight of the solution. The sulphide-rich white liquor is separated from the sodium carbonate, sodium sulphide and insoluble inerts of the slurry to yield a cake with about 85% solids and 15% solution by weight and a clear sulphide-rich white liquor. The cake is dissolved in weak wash from the causticizing plant to yield a solution with the same total alkali content as that of the green liquor of the reference case. The causticizing reaction is assumed to proceed to a causticity equivalent to about 95% of the equilibrium causticity as was assumed for the reference case. As can be seen upon comparing Tables 1 and 2, the total yield of sodium hydroxide from the sodium carbonate content of the smelt is about 6% higher for the white liquor preparation process of the invention compared to the conventional process of the reference case.

Impact on Digesting Process

Table 3 shows water balances for a modified continuous digesting process with divided alkali charges, both in combination with the reference case and with the process of this invention.

Table 3

Presteaming condensate (tonnes/tonnes bone dry wood)	0.29	0.29
Condensate from direct medium pressure steam (tonnes/tonnes bone dry wood)	0.14	0.12
White liquor	1.33	0.70
- Sulphide-rich (tonnes/tonnes bone dry wood)	N/A	0.32
- Sulphide-lean (tonnes/tonnes bone dry wood)	N/A	0.38
Wood Moisture (tonnes/tonnes bone dry wood)	2.00	2.00
Total water added	2.76	2.11
Sodium sulphide charged (kg/tonne of bone dry wood) to impregnation vessel or trim circulation	62.1	74.5
Sodium sulphide concentration (kg/tonne of water)	22.5	35.3

With the process of this invention, the sulphide-rich white liquor is charged to the impregnation vessel or its top circulation. Any remaining sulphide-rich white liquor is charged to the digester trim circulation.

The sulphide-lean white liquor is preferentially charged to the countercurrent phase of the cook. The excess effective alkali produced by the white liquor preparation process of this invention, compared to the

conventional process of the reference case, is used as sulphide-lean white liquor elsewhere outside the digesting process. For example, the alkali content and quality of this excess stream matches well the requirements of an oxygen delignification plant as frequently used to further delignify the pulp following the digesting process.

The relative increase in sulphide concentration at the trim circulation as shown in Table 3 of 57% is equivalent to increasing the sulphidity of the white liquor of the conventional process from about 35% to about 50%.

Smelt Separation and Countercurrent Impregnation

The relative hydrosulphide concentration in the initial and bulk delignification stages of the digesting process can be further increased if smelt separation is combined with black liquor countercurrent impregnation of the wood prior to the charging of the sulphide-rich white liquor. The black liquor used for impregnation should be extracted from a position above the normal extraction strainer plate to ensure the highest possible sulphide concentration and a suitable alkali content.

Calculations indicate that theoretically the hydrosulphide concentration during the initial bulk delignification phases could be more than doubled by such a process combination. However, in reality, the practical maximum hydrosulphide concentration may be limited by the maximum acceptable dissolved lignin concentration during the initial and bulk delignification phases of the process.

Advantages

A relative increase in hydrosulphide concentration in the kraft digesting process can provide the following benefits:

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1. Utilizing the increased hydrosulphide concentration in the digesting process to improve pulp strength properties.

2. Utilizing the increased hydrosulphide concentration in the digesting process to extend the delignification.

3. Maintaining the hydrosulphide concentration in the digesting process at the same level as in conventional processes while utilizing the resulting excess sulphide, either as is or after conversion to polysulphide or/and sulphite, for pre- or post-treatment of the wood/pulp to achieve higher yield, extended delignification, or improved pulp properties.

4. Achieving a decreased sulphur-to-sodium ratio in the recovery cycle to reduce emissions to air of sulphur containing compounds.

Benefit 2 above has been discussed previously in general terms. Benefit 3 enables the reduction of kappa numbers, and a number of different processes for pre-treatment of wood chips before or for post-treatment of pulp after the kraft pulping process have been described: Johansson, B. and Teder, A., "Modified kraft processes - a way to reduced environmental influence and reduced energy consumption", Proceedings of the 2nd World Congress of Chemical Engineering, Montreal, p. 235-242, 1981; Kleppe, P.J., "Process for delignification of wood pulp", Canadian Patent No. 1,221,809, 1984; Hartler, N. and Olsson, L.A., "Hydrogen sulphide cooking - Part 1, first stage variables", Svensk Papperstidning 75:13, p. 559-565, 1972; Cox, L.A. and Worster, H.E., "A status report on MacMillan Bloedel's hydrogen sulphide-kraft pulping process", Pulp &

Paper Magazine of Canada 73:9, p. 106-109, 1972; Andrews, E.K., Chang, H-m, Kirkman, A.G. and Eckert, R.C., "Extended delignification in kraft and kraft/oxygen pulping of softwood by treatment with sodium sulphide liquors", Japan TAPPI International Symposium on Wood Pulp Chemistry, p. 177-182, 1982; and Kirkman, A.G., Andrews, E.K., Chang, H-m., "Impact on extended delignification using green liquor pretreatments on kraft mill chemical and energy balances", AIChE Symposium Series 86, p. 66-73, 1984.

Many such processes would, however, require either a much higher total chemicals consumption or a very high S/Na-ratio in the recovery process, making them difficult to introduce utilizing conventional recovery processes.

For some of the process configurations, this can be changed if the sulphide demand of the kraft pulping stage of the process is reduced.

In laboratory scale simulated Extended Modified Continuous Cooking (EMCC), superior results were obtained by applying the major part of the sulphide-rich liquor in the second, "co-current" liquor charge which was made at the beginning of the bulk delignification phase, rather than applying the sulphide-rich liquor exclusively in the first "impregnation" liquor charge, which is made some 30 minutes earlier.

1. A kraft pulping process including initial, bulk and final phases of delignification of lignocellulosic materials and utilizing split white liquor charges, said process comprising:

(a) producing a sulphide-rich white liquor stream by leaching solids of a recovery boiler smelt with a sulphide-lean white liquor having a sodium hydroxide content less than 15 percent by weight, said sulphide-rich white liquor containing sodium sulphide and sodium hydroxide in aqueous solution and solid particles containing sodium carbonate;

(b) separating the solid particles from the sulphide-rich white liquor;

(c) dissolving the sodium carbonate content of the solid particles in water or a weak wash from a causticizing plant to form a sodium carbonate solution;

(d) producing a stream of the sulphide-lean white liquor by causticizing the sodium carbonate solution to a sulphide-lean white liquor in a causticizing plant; and

(e) recycling at least part of the sulphide-rich white liquor to the initial phase of the delignification of lignocellulosic materials.

2. A process according to claim 1 wherein any excess sulphide-rich white liquor from the initial phase is directed to the beginning of the bulk delignification phase.

3. A process according to claim 1 wherein the sulphide-lean white liquor obtained from causticizing the carbonate content in the smelt is used as liquor for recovery boiler smelt leaching.

4. A process according to claim 1 wherein a portion of the sulphide-rich white liquor, the solid sodium carbonate, the carbonate solution or the sulphide-lean

white liquor are used in other pulping processes, pulp oxygen delignification plants, pulp bleaching plants or flue gas scrubbing processes.

5. A process according to claim 1 wherein the sodium carbonate is purified to produce a material with a low sulphide content.

6. A process according to claim 4 wherein the sodium carbonate is purified by washing.

7. A process of generating a sulphide-rich white liquor and a sulphide-lean white liquor characterized by:

(a) introducing smelt from a recovery boiler into a smelt hopper, said smelt containing molten sodium sulphide and sodium carbonate;

(b) flushing the smelt with a liquid whereby the smelt is dispersed and solidified into particles;

(c) separating the particles into small and large particles and passing the small particles into a slurry tank where sodium sulphide is preferentially dissolved from the particles;

(d) passing the large particles into a weak liquor tank and dissolving the large particles therein;

(e) adding a sulphide-lean white liquor obtained from a causticizing plant to the weak liquor tank;

(f) separating the contents of the slurry tank into a sulphide-rich white liquor containing sodium sulphide and sodium hydroxide, and a solid containing sodium carbonate;

(g) dissolving the solid containing sodium carbonate in a weak wash obtained from the causticizing plant, and causticizing the resulting solution in order to generate a sulphide-lean white liquor; and

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(h) recycling the sulphide-rich white liquor to an initial phase of a digestion process for delignification of lignocellulosic materials.

8. A process according to claim 7 wherein sodium carbonate used to produce the sulphide-lean white liquor is washed to produce a product with a low sulphide content.

9. A process according to claim 7 wherein any excess sulphide-rich white liquor from the initial phase of the process of step (h) is directed to the beginning of a bulk delignification phase of the process.

10. A kraft pulping process characterized by:

(a) delignifying lignocellulosic material in at least an initial delignification phase and a bulk delignification phase;

(b) producing a sulphide-rich white liquor stream;

(c) producing a sulphide-lean white liquor stream by causticizing a sodium carbonate solution prepared from solid sodium carbonate;

(d) recycling at least a part of the sulphide rich white liquor stream to the initial delignification phase; and

(e) recycling at least a part of the sulphide-lean white liquor stream to a final phase of the delignification process.

11. A process according to claim 10 wherein any excess sulphide-rich white liquor is directed to the beginning of the bulk delignification phase.

12. A process according to claim 10 wherein the sulphide-rich white liquor stream is obtained by leaching solids of a recovery boiler smelt.

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13. A process according to claim 10 wherein a major portion of the sulphide-rich white liquor stream is applied to a second co-current liquor charge which is made at the beginning of the bulk delignification phase.

14. A process according to claim 1 wherein the solids of the recovery boiler smelt are leached with water instead of sulphide-lean white liquor having a sodium hydroxide content less than 15 percent by weight.

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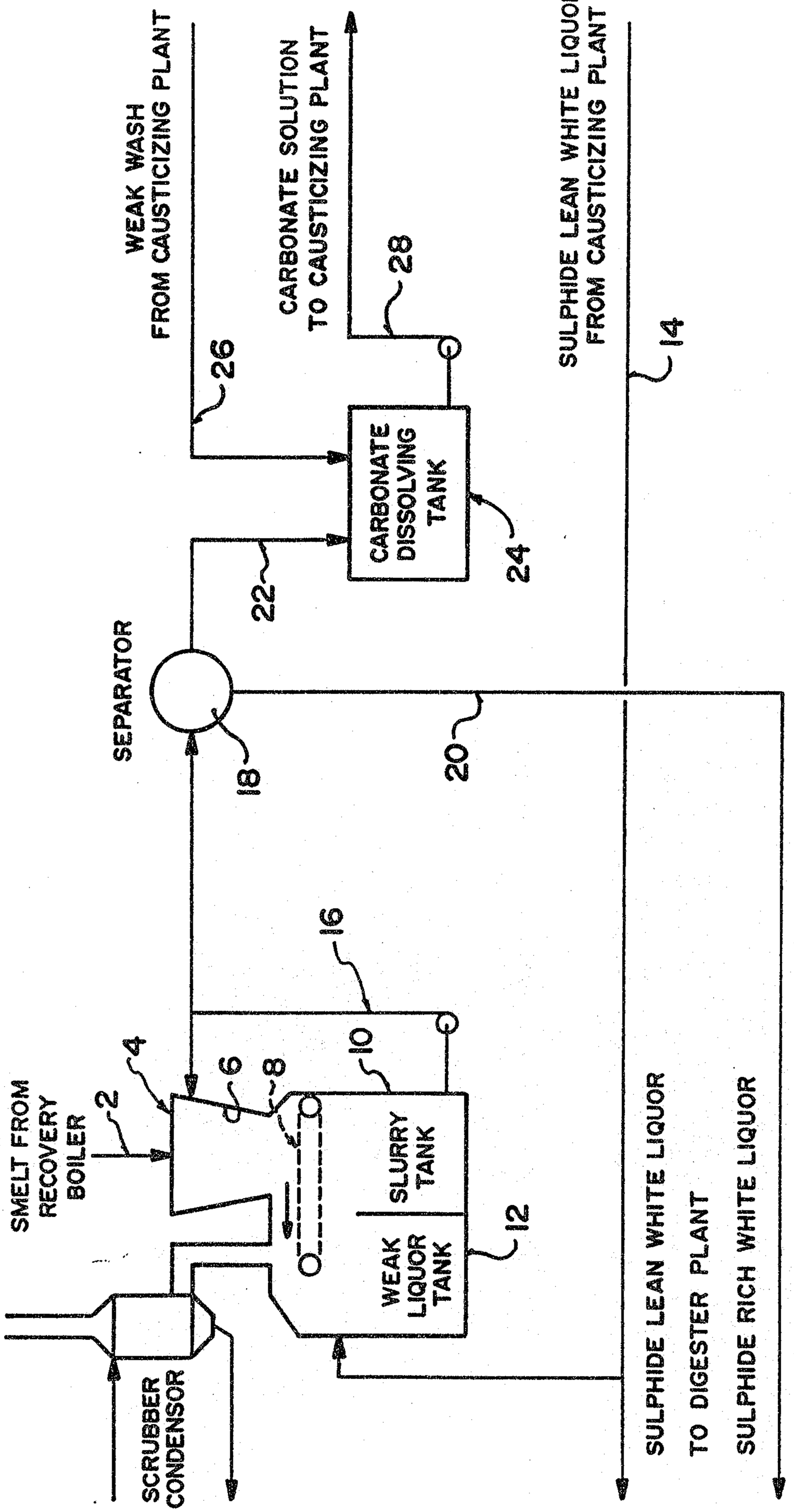

FIG. 1

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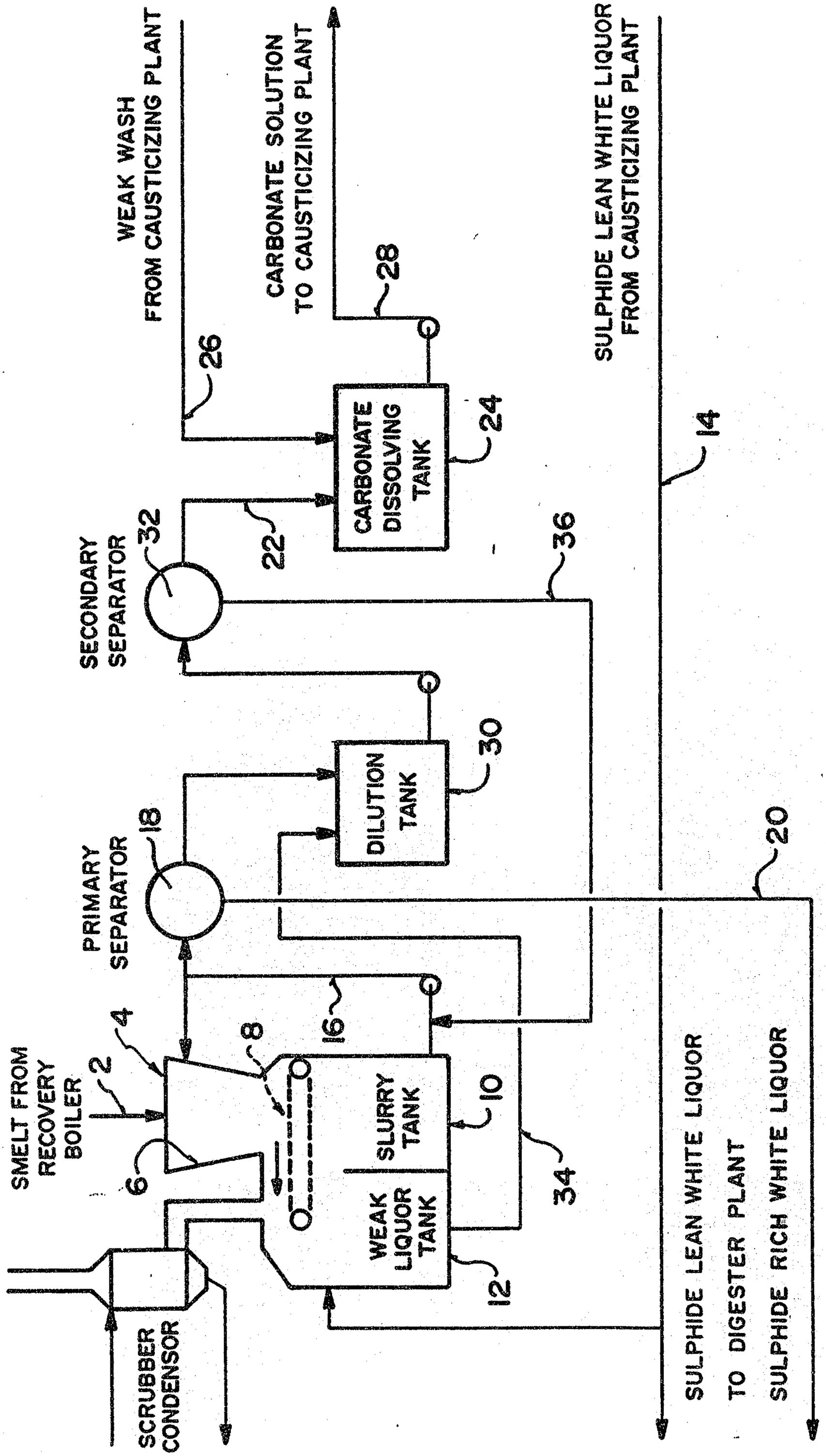
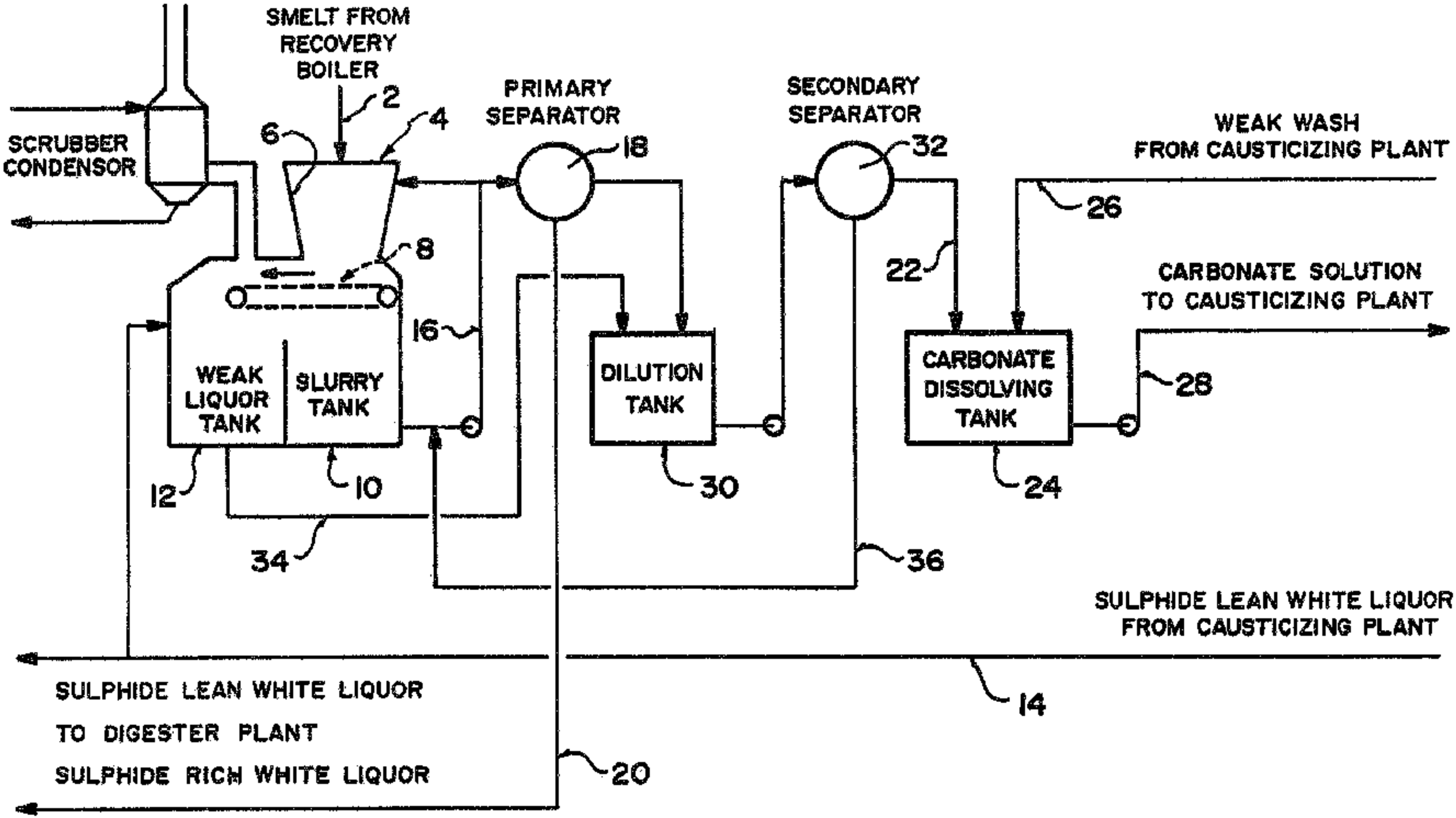


FIG. 2


SMELT FROM RECOVERY BOILER
2
4
6
SCRUBBER CONDENSOR
PRIMARY SEPARATOR
18
SECONDARY SEPARATOR
32
WEAK WASH FROM CAUSTICIZING PLANT
26
8
22
CARBONATE SOLUTION TO CAUSTICIZING PLANT
16
WEAK LIQUOR TANK
SLURRY TANK
DILUTION TANK
CARBONATE DISSOLVING TANK
28
12
10
30
24
34
36
SULPHIDE LEAN WHITE LIQUOR FROM CAUSTICIZING PLANT
14
SULPHIDE LEAN WHITE LIQUOR TO DIGESTER PLANT
SULPHIDE RICH WHITE LIQUOR
20