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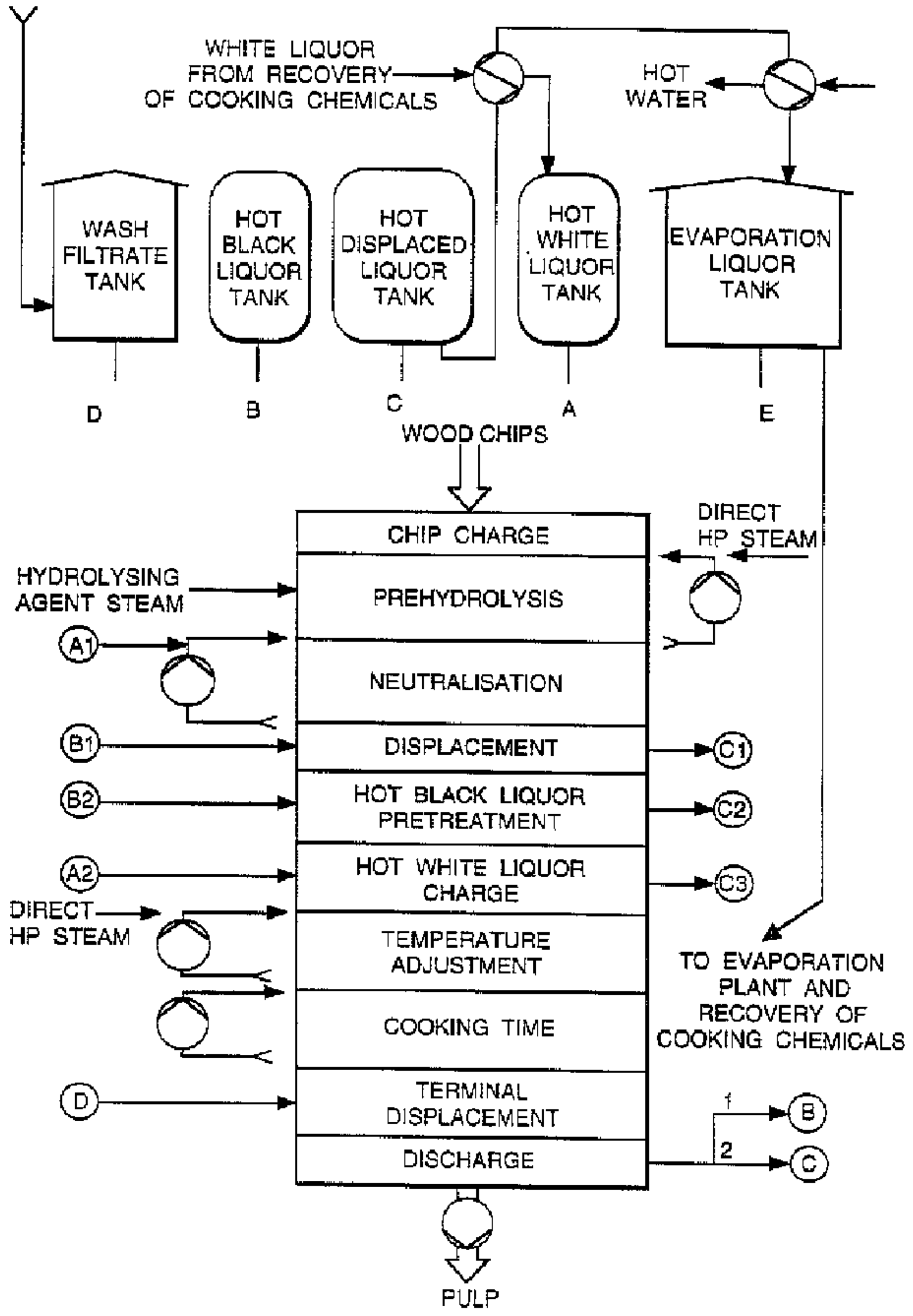
(54) **Titre** : PRODUCTION DE PATE PREHYDROLYSEE
(54) **Title**: PRODUCTION OF PREHYDROLYZED PULP



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neutralized hydrolysate from the reactor and delignifying the neutralized prehydrolyzed cellulosic material with alkaline cooking liquor containing sodium sulfide and sodium hydroxide.

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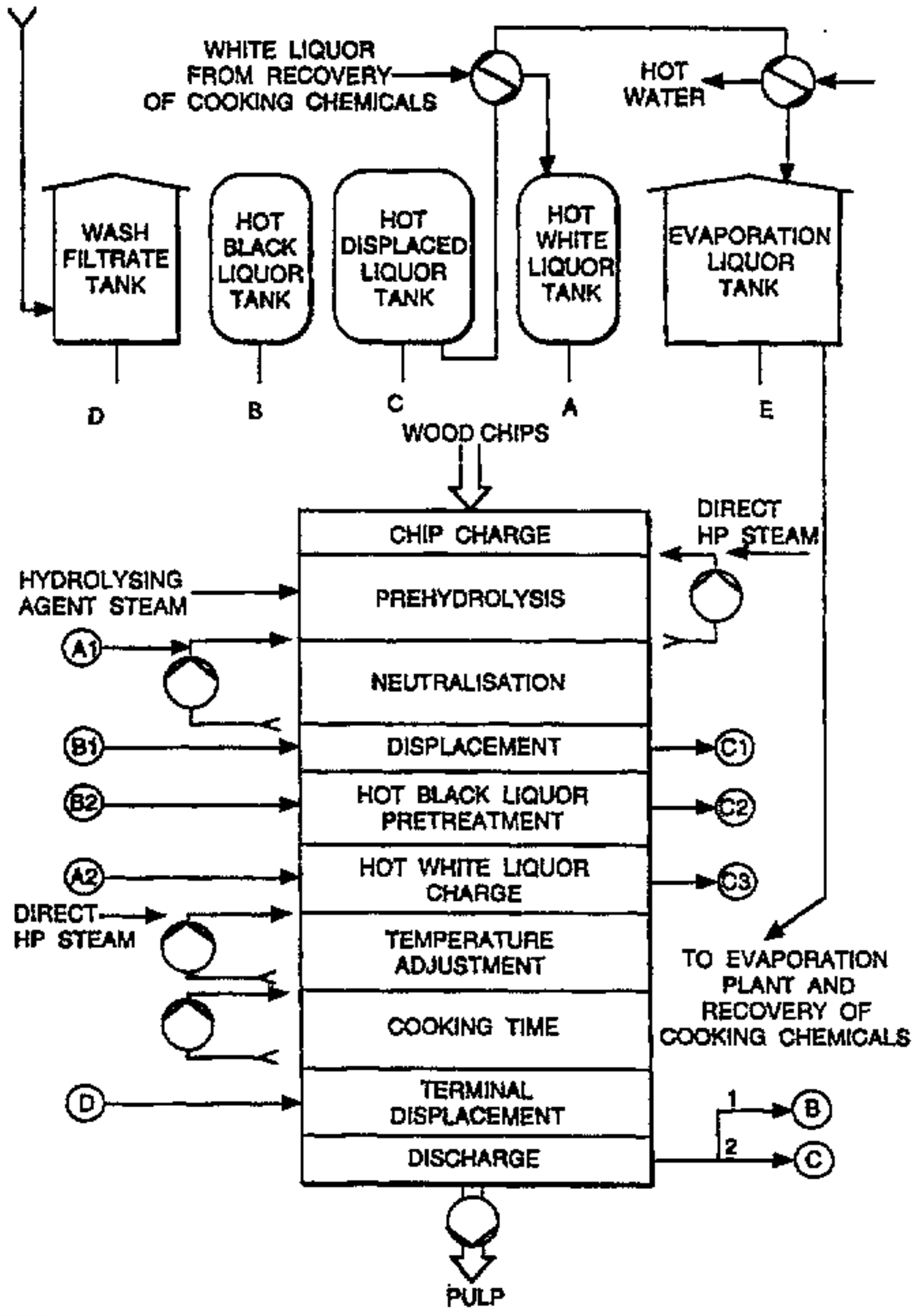
(54) **Title:** PRODUCTION OF PREHYDROLYZED PULP

(57) **Abstract**

Process for preparing pulp from ligning-containing cellulosic material are disclosed including a prehydrolysis step followed by neutralizing hydrolysate and the prehydrolyzed cellulosic material in the reactor with alkaline neutralizing liquor, removing the neutralized hydrolysate from the reactor and delignifying the neutralized prehydrolyzed cellulosic material with alkaline cooking liquor containing sodium sulfide and sodium hydroxide.



PRODUCTION OF PREHYDROLYZED PULP

TECHNICAL FIELD

The present invention relates to a process for the production of special pulp from material lignocellulose-containing. In the process, hemicelluloses are hydrolysed into hydrolysate, and lignin is dissolved by a kraft cooking method for liberating cellulose fibers. The produced pulp has a high content of alpha cellulose and can be used e.g. as dissolving pulp.

BACKGROUND OF THE INVENTION

Traditionally, there are two processes for the production of special pulps having a high content of alpha cellulose: the far-extended acidic bisulfite cooking, and the prehydrolysis-sulfate (kraft) cooking. The former was developed at the beginning of the 20th century, and the latter in the 1930's, see e.g. Rydholm, S.E., Pulping Processes, p. 649 to 672, Interscience Publishers, New York, 1968. The basic idea in both processes is to remove as much hemicellulose as possible from cellulose fibers in connection with delignification so as to obtain a high content of alpha cellulose. This is essential because the various end uses of such pulps, dissolving pulp for instance, do not tolerate short-chained hemicellulose molecules with randomly grafted molecular structure.

In the traditional sulfite process, the removal of hemicellulose takes place during the cooking simultaneously with dissolving of the lignin. The cooking conditions are highly acidic, and the temperature varies from 140 °C to 150 °C, whereby the hydrolysis is emphasized. The result, however, is always a compromise with delignification. No higher content of alpha cellulose is obtained. Another drawback is the decrease in the degree of polymerization of cellulose and yield losses, which also limit the potential for hydrolysis. Various improvements have been suggested, such as modification of cooking conditions, and even a prehydrolysis step followed by an alkaline sulfite cooking stage. In spite of developments in connection with sulfite special pulp processes, the number of sulfite pulp mills in operation have decreased and new developments have not been adopted. The main obstacle in connection with sulfite pulping processes is the complicated and costly recovery processes of the cooking chemicals, particularly of the sulfite itself.

A separate prehydrolysis step permits the desired adjustment of the hydrolysis of hemicelluloses by varying the hydrolysis conditions. In the prehydrolysis-kraft cooking process the necessary delignification is not carried out until in a separate second cooking step. The prehydrolysis is carried out either as a water or steam phase prehydrolysis or in the presence of a catalyst. In the former processes, organic acids liberated from wood in the process perform a major part of the hydrolysis, whereas in the latter, small amounts of mineral acid or sulfur dioxide are added to "assist" prehydrolysis. The delignification step has been a conventional kraft cooking method, where white liquor has been added to the digester and the cooking has been carried out as a single step after removing some or none of the prehydrolysate. One of the drawbacks of this process is e.g., that the neutralized hydrolysate (free hydrolysate left in the digester, as well as immobilized hydrolysate inside the chips) causes consumption of cooking chemicals and loading of the digester.

SUMMARY OF THE INVENTION

In accordance with one embodiment of the present invention there is provided a method for the batchwise preparation of prehydrolysis-kraft pulp from lignin-containing cellulosic material, comprising the steps of: (a) prehydrolyzing the material in a batch digester so as to produce prehydrolyzed cellulosic material and hydrolysate; (b) neutralizing the hydrolysate and the prehydrolyzed cellulosic material in the digester at a temperature of 140-160°C with alkaline neutralizing liquor containing sodium hydroxide and sodium sulfide, whereby the alkali charge of aid neutralizing liquor is 5-25% active alkali calculated as Na_2O equivalents on dry wood so as to produce neutralized hydrolysate and neutralized prehydrolyzed cellulosic material, and a residual alkali content of 1-20 g effective NaOH/l; (c) removing the neutralized hydrolysate from the digester; and (d) delignifying the neutralized prehydrolyzed cellulosic material with alkaline cooking liquor containing sodium sulfide and sodium hydroxide.

According to a preferred embodiment, the prehydrolyzed material is neutralized with fresh cooking liquor, and the neutralized hydrolyzate is removed by displacement with spent cooking liquor.

When compared with the traditional prehydrolysis-kraft process, the present invention offers e.g. following advantages:

- The consumption of cooking chemicals is lower.
- The content of the so called heavy transition metal ions, such as Mn, Cu, Fe etc., in the cooked pulp is decreased. This is achieved because the acidic prehydrolysis dissolves most of the metal ions, and the dissolved ions are removed before the cooking step. In the traditional process, the metals precipitate back to the cellulose fibers in the alkaline cooking phase. The heavy transitional metal content is a critical parameter when applying non-chlorine bleaching chemicals, such as peroxide and ozone which are rapidly destroyed by these metals ions.
- A neutralization can be carried out independently, and it is possible to optimize the alkali charge between the neutralization and cooking steps.

Material to be used in the process is suitably softwood or hardwood, preferably hardwood such as, e.g., eucalyptus species, beech, or birch.

Suitable neutralizing agents contain caustic soda. The preferred agent is alkaline kraft cooking liquor, i.e., white liquor. A suitable neutralization time is 10-40 min, preferably 20-30 min, which is enough to get the digester content mixed. A suitable neutralization temperature is 140-160°C. A suitable neutralization alkali charge is 5-25% active alkali calculated as Na_2O equivalents on dry wood. This results in a neutralization residual alkali concentration of 1-20 g of effective NaOH/liter, depending on the wood species and charge.

The removal of neutralized hydrolysate is suitably carried out by displacement with hot black liquor originating from a previous cook. The hot displaced black liquor preferably has a residual alkali concentration of 10-25 g of effective NaOH/ liter, a pH 12.5-13.5, and a temperature between 150-

180 °C. The hot black liquor reacts with the wood material, whereby the residual alkali concentration of the hot black liquor is consumed, and pH is decreased. The displacement with hot displaced black liquor suitably provides a reaction time of 10 - 30 minutes. The reaction facilitates the delignification with fresh alkaline cooking liquor in the cooking step.

The displacement is continued with fresh alkaline cooking liquor (white liquor) introducing the cooking alkali charge, which preferably is 5 - 15 % active alkali calculated as Na_2O equivalents on dry wood. The portion of sodium sulfide of the white liquor active alkali (the sulfidity) is suitably 15 - 45 % calculated as Na_2O equivalents. The preferable temperature of the alkaline cooking liquor is 150 - 180 °C.

The cooking phase is suitably carried out by circulating the cooking liquor 10 - 120 min and adjusting the desired cooking temperature by means of high pressure steam, preferably by direct steam injection to the circulating cooking liquor. A suitable cooking temperature is 150 - 180 °C, preferably 150 - 165 °C for hardwoods, and 155 - 170 °C for softwoods.

The cooking step is preferably terminated by displacing the hot black liquor by means of using cooler liquor, preferably a wash filtrate having, e.g., a temperature of 60-90 °C. The hot displaced black liquor, which is rich in dissolved solids and sulfur compounds is preferably recovered for re-use, and the heat of the rest of the displaced hot liquor is recovered by heat exchange.

The pulp is suitably discharged from the digester by pumping.

The displacements are preferably carried out from the bottom to the top of the reactor.

According to the present invention, prehydrolysis-kraft pulp can be delignified to lower residual lignin concentration while maintaining excellent pulp quality in terms of pulp viscosity and alpha cellulose purity, for such end uses as dissolving and other special pulps. Simultaneously the energy economy of the process can be improved.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a schematic representation of the tanks and liquor transfer sequences according to a process in accordance with the present invention.

DETAILED DESCRIPTION OF PREFERABLE EMBODIMENTS

In figure 1, the cooking steps, the liquor transfer sequences, and the tanks for liquors are presented.

A prehydrolysis step is first carried out. Suitable prehydrolyzing agents include, e.g., water as circulating liquid or in the steam phase, aqueous solutions of mineral acids such as sulfuric or hydrochloric acid, sulfur dioxide and acid bisulfite cooking liquor. Preferable prehydrolyzing agents for softwoods include water, and for hardwoods water, sulfuric acid or sulfur dioxide. A suitable prehydrolyzing temperature is 100 - 160 °C for softwoods and 120 - 180 °C for hardwoods. A suitable hydrolyzing time is 10 to 200 min, preferably 20 - 120 minutes.

If desired, part of the hydrolysate can be recovered before the neutralization step, and can be used, for example, for producing ethanol.

After the prehydrolysis step, the present process deviates from prior art prehydrolysis-kraft processes. The prehydrolysis is followed by a new, individual step; the neutralization step. The primary purpose of this step is to neutralize the hydrolysate left in the digester. There is hydrolysate both in the free liquid outside the chips and also trapped and immobilized inside the chips.

In order to carry out the neutralization, fresh hot white liquor A1 is pumped from tank A into the digester so as to displace the hydrolysate from outside the chips. The neutralization is completed by circulating the liquor in the digester, and thus mixing the content.

In the neutralization step, contents of the digester are prepared for later delignification, to be carried out by alkaline kraft cooking. Neutralization is achieved by selecting an appropriate neutralizing alkali charge which results in clearly alkaline neutralization end point. The residual alkali concentration is preferably 5 - 15 g effective NaOH/liter. This levels out fluctuations in terms of improper alkali charge and pulp quality due to fluctuating consumption of the single alkali charge by the neutralization.

In addition to the primary neutralization function, the neutralization step also serves as an alkaline hemicellulose dissolving step. The strong alkali and the high temperature directly dissolve and, on the other hand, degrade hemicelluloses by the so called end-wise peeling reaction. The pulp is thus further purified, which leads to higher pulp viscosity and higher alpha cellulose content. In other words, the neutralization step also becomes, in part, an alkaline extraction stage prior to the cooking step. Therefore the liquor-to-wood ratio in this step is preferably relatively low, between about 2.5 - 3.5.

After the neutralization step is completed, hot displaced black liquor B1 from previous cooks is pumped from tank B to the digester. The black liquor B1 begins to displace the neutralized hydrolysate C1 out of the digester. The hydrolysate C1 is led to the hot displaced liquor tank C. The removal of the neutralized hydrolysate is advantageous because it removes the dissolved hemicelluloses and their degradation products before the cooking phase, where the presence of these substances would require extra alkali and the delignification selectivity would be compromised. It is also noteworthy that the heavy metal ions, such as e.g. Mn, Fe, Cu, and Co, dissolved in the acidic prehydrolysis step, are removed from the digester, and thus the disadvantageous metal ion content of the cooked pulp is lowered. This facilitates oxidative bleaching of the pulp with oxygen, peroxide and ozone.

The hot black liquor flow to the digester is continued by flow B2 from the tank B, turning the entire contents of the digester to be submerged in the hot black liquor, and the temperature of the digester content comes close to the temperature of the hot black liquor which, in turn, is close to the cooking temperature. The displaced liquor C2 flows to the hot displaced liquor tank C.

The sulfide rich hot black liquor reacts with the wood material and greatly facilitates the delignification with fresh alkaline cooking liquor in the cooking step. The hot black liquor reaction step is carried out for a period of from 10 - 30 minutes, whereby the residual alkali concentration of the hot black liquor, which is preferably 10 - 25 g effective NaOH/l, is consumed to preferably 1 - 10 g effective NaOH/l. At the end point of the hot black liquor reaction step, the pH of the hot black liquor, preferably 12.5 - 13.5, is decreased to between about 9.5 - 11.5 in the liquor inside the chips and between about 11.5 - 12.5 in the free liquor outside the chips. By this method the process conditions are rendered very advantageous for the forthcoming final delignification.

After the hot black liquor treatment step, hot white liquor A2 from the tank A is pumped to the digester displacing a corresponding volume C3 of the hot black liquor based cooking liquor to the hot displaced liquor tank C. In this manner all of the hot displaced liquor from the digester have been introduced to the hot displaced liquor tank C. The hot liquor from this tank is led through heat-exchangers to an atmospheric evaporation liquor tank E which serves as a buffer tank discharging the liquor to the evaporation plant and recovery of cooking chemicals. It is to be noted that all leaving liquors from the initial liquor sequences are collected to one tank, and one liquor heat recovery system thus effectively deposes of all prehydrolyzed dissolved substances from the process before the final delignification in the cooking step.

Hot liquor from the tank C is used to heat white liquor to be pumped to the tank A, and to prepare hot water.

The hot white liquor addition A2 starts the kraft cooking step, i.e. the final delignification. Due to the high temperature of the hot black liquor, the starting temperature after the white liquor addition A2 is high, close to the desired cooking temperature. Therefore the heating-up step is in fact a temperature adjustment step, where the need to heat up is preferably only 1 - 10 °C. This can be achieved by simple direct high pressure steam flow to the circulation pipe line, thus avoiding expensive heat-exchangers.

Due to the preparatory hot black liquor treatment, the cooking step is very short. The degree of reaction of the digestion conditions which is required (i.e., reaction temperature and time) is generally determined by the so-called H-factor. Prior art prehydrolysis kraft cooking with hardwoods requires 800 - 1200 H-factor units to complete the delignification, whereas the present prehydrolysis-displacement kraft cooking process needs only about 400 H-factor units to reach the same and even higher delignification degree. If the same cooking temperature would be used, this means cutting the cooking time to 35 - 50 % of that of the prior art conventional prehydrolysis-kraft cooking time. The consequence of greatly reduced need for cooking time is that the cooking step can be made very mild providing improved pulp quality. For instance, if the cooking advantage of H-factor 400, instead of the conventional H-factor requirement of 1000, is converted to lower cooking temperature, it is possible to use the cooking temperature 159 °C in stead of the conventional 170 °C. This means a dramatic decrease in the rate of the random alkaline hydrolysis of the cellulose molecule, and a greatly improved pulp viscosity at the same delignification degree, i.e., at the same kappa number level. In today's pulping technology the high unbleached pulp intrinsic viscosity is very valuable, since the new more and more compulsory total chlorine free oxidative bleaching sequences compromise the viscosity much more severely than the conventional and more selective chlorine chemicals based bleaching. In this manner, the present invention enables the production of high quality prehydrolysis-kraft pulp by using totally chlorine free bleaching sequences.

The cooking step is terminated by the displacement of the cooking liquor with cool, preferably 60 - 90 °C, displacement liquor from the tank D. This liquor is preferably filtrate from the pulp wash plant. The first portion B of the displaced black liquor consists of pure black liquor and covers the dry solids rich portion of the displaced liquor. The volume of this displaced portion varies depending on the wood density and digester filling degree, but is usually referably close to the free liquor volume of the digester, typically between about 60 - 70 % of the digester total volume. When the dry solids contents of the displaced hot liquor coming out of the digester starts to drop, the flow is separated as a second flow C turned to the hot displaced liquor tank C. The separation is done according to a precalculated volume or by monitoring the dissolved solids concentration of the displaced liquor. In this manner, the displaced liquor which is still hot but has been diluted by the displacement liquor is recovered to the hot displaced liquor, tank C which sends its content through the heat exchange only to the evaporation liquor tank E and out of the cooking process. The result is that only the dissolved solids and sulfur chemicals rich hot black liquor B is re-used in the displacement of the neutralized hydrolysate and in the subsequent hot black liquor treatment.

The digester is discharged after the terminal displacement step by pumping the content out.

The following examples further illustrate the invention as compared with conventional processes.

Example 1. Production of prehydrolysis-kraft pulp by means of a conventional prehydrolysis-kraft-batch process from Eucalyptus Grandis chips

Chips were metered into a chip basket positioned in a 35-liter forced circulation digester. The cover of the digester was closed and the prehydrolysis was carried out according to the temperature program by introducing direct high pressure steam into the digester. After the hydrolysis time had passed, the cooking liquor charge was pumped into the digester and the digester circulation started. The cooking was carried out according to the cooking temperature program by heating the digester circulation be mens of steam. At the end of the cooking, the cooking liquor was rapidly cooled and the spent liquor discharged. The pulp was washed in the digester and then discharged from the cooking basket to disintegration for 3 minutes. After the disintegration, the pulp was dewatered and the total yield determined. Then the pulp was screened on a 0.25 mm slotted screen. Shives were measured and the accept fraction was dewatered and analyzed. The conditions were:

Prehydrolysis step

Wood amount, g of abs. dry chips	2000
Prehydrolyzing agent	direct steam
Temperature rising, min	60
Prehydrolysis temperature, °C	170
Prehydrolysis time, min	25

Kraft cooking step

Active alkali charge, % on wood as Na_2O	18
White liquor sulfidity, %	36
Temperature rising time, min	60
Temperature, °C	170
Cooking time, min	60
Cooking H-factor	1100
Yield, % on wood	38.4
Shive content, % on wood	0.1
Kappa number	10.0
Viscosity SCAN, dm^3/kg	905
Alkali solubility S5, %	2.4
Brightness, % ISO	34.0

Example 2. Production of prehydrolysis-kraft pulp by means of a conventional prehydrolysis-kraft-batch process from Eucalyptus Grandis chips

The experiment was carried out as disclosed in Example 1, but under following conditions:

Prehydrolysis step

Wood amount, g of abs. dry chips	3000
Prehydrolyzing agent	direct steam
Temperature rising, min	60
Prehydrolysis temperature, °C	170
Prehydrolysis time, min	25

Kraft cooking step

Active alkali charge, % on wood as Na_2O	19.5
White liquor sulfidity, %	36
Temperature rising time, min	30

Temperature, °C	165
Cooking time, min	60
Cooking H-factor	800
Yield, % on wood	40.2
Shive content, % on wood	0.6
Kappa number	14.1
Viscosity SCAN, dm^3/kg	1220
Alkali solubility S5, %	2.7
Brightness, % ISO	32.3

Example 3. Production of prehydrolysis-kraft pulp by means of a batch process in accordance with the invention from Eucalyptus Grandis chips.

Chips were metered into a chip basket positioned in a 35-liter forced circulation digester. The cover of the digester was closed and the prehydrolysis was carried out according to the temperature program by introducing direct high pressure steam into the digester. After the hydrolysis time had passed, neutralization white liquor was pumped into the digester and the circulation was started. After the neutralization time had passed the circulation was stopped and hot black liquor was pumped into the digester bottom. The pumping first filled the digester up and then continued as displacement ousting liquor from the top of the digester. The hot black liquor pumping was stopped after the desired volume was pumped in. The digester circulation was started again, and the desired temperature was reached. After the hot black liquor treatment time had passed, the cooking white liquor charge was pumped into the digester bottom displacing the hot black liquor from the top of the digester. After the desired alkali charge has entered, the digester circulation was started and the digester heated to the desired cooking temperature. After the desired cooking time had passed, the cook was terminated as disclosed in the example 1.

Prehydrolysis step

Wood amount, g of abs. dry chips	3000
Prehydrolyzing agent	direct steam
Temperature rising, min	60
Prehydrolysis temperature, °C	170
Prehydrolysis time, min	25

Neutralization step

Neutralization alkali charge, % on wood as Na_2O	11.5
Neutralization temperature, °C	155
Neutralization time, min	15

Hot black liquor displacement and treatment step

Hot black liquor residual effective alkali as g NaOH/l	20.4
Hot black liquor volume as % of digester volume	60
Hot black liquor treatment, temperature, °C	148
Hot black liquor treatment time, min	20

Cooking step

Active alkali charge, % on wood as Na_2O	7
White liquor sulfidity, %	36
Temperature adjustment, °C	+7
Temperature adjustment time, min	10
Cooking temperature, °C	160
Cooking time, min	54
Cooking H-factor	400
Yield, % on wood	39.7
Shive content, % on wood	0.17
Kappa number	9.1
Viscosity SCAN, dm^3/kg	1220
Alkali solubility S5, %	2.8
Brightness, % ISO	40.0

Today's stringent environmental protection issues practically outlaw the use of chlorine compounds in the bleaching of kraft pulp. This will be even more true in the future for high alpha cellulose special pulps which find use for example in hygienic products such as cotton wool. Therefore, the bleaching must be carried out by using oxidative bleaching agents such as oxygen, hydrogen peroxide and ozone. As these bleaching methods are significantly less selective and thus compromise the pulp quality significantly more in the bleaching, the unbleached pulp quality must be higher than before. For example, the following requirements have been stated for an unbleached Eucalyptus pulp for total chlorine free bleaching:

Kappa number	< 10
SCAN viscosity, dm^3/kg	> 1200
S5 solubility, %	2 - 3.5

Before these new requirements, the desired viscosity was 1050 - 1100 dm^3/kg, and it could be achieved by delignifying less, in other words cooking to higher kappa number, typically to 11 - 13 for Eucalyptus grandis. This kind of conventional Eucalyptus prehydrolysis-cook resulted in about 40 % yield.

Example 1 demonstrates the results from a conventional prehydrolysis-kraft batch cook, where the delignification has been extended to kappa number 10. As can be seen, the pulp viscosity is too low. In addition, the pulp yield is quite low increasing the manufacturing costs.

Example 2 shows the result, when the conventional prehydrolysis-kraft batch cook has been changed to produce the required pulp viscosity 1200 dm^3/kg by adding alkali charge and cutting down cooking time and temperature. As a result, the kappa number stays much too high for the above requirements.

Example 3 demonstrates the result, when the process is carried out according to the present invention. The required viscosity 1200 dm3/kg has been reached while achieving the delignification down to the kappa number 9.1, and the pulp yield close to the conventional 40 %, which has been the case at about 50 % higher kappa number level of 14. The alkali solubility percentage was well acceptable and fairly constant in all examples.

Another proof for better bleachability of the pulp produced according to the present invention is the brightness of the unbleached pulp. The conventional prehydrolysis pulp in examples 1 and 2 show the brightness 32 - 34 % ISO, whereas the pulp in example 3 has the brightness 40 % ISO; i.e., a significant 20 % improvement in brightness and bleachability.

Although the invention herein has been described with reference to particular embodiments, it is to be understood that these embodiments are merely illustrative of the principles and applications of the present invention. It is therefore to be understood that numerous modifications may be made to the illustrative embodiments and that other arrangements may be devised without departing from the spirit and scope of the present invention as defined by the appended claims.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A method for the batchwise preparation of prehydrolysis-kraft pulp from lignin-containing cellulosic material, comprising the steps of:

(a) prehydrolyzing said material in a batch digester so as to produce prehydrolyzed cellulosic material and hydrolysate;

(b) neutralizing said hydrolysate and said prehydrolyzed cellulosic material in said digester at a temperature of 140-160°C with alkaline neutralizing liquor containing sodium hydroxide and sodium sulfide, whereby the alkali charge of said neutralizing liquor is 5-25% active alkali calculated as Na_2O equivalents on dry wood so as to produce neutralized hydrolysate and neutralized prehydrolyzed cellulosic material, and a residual alkali content of 1-20 g effective NaOH/l;

(c) removing said neutralized hydrolysate from said digester; and

(d) delignifying said neutralized prehydrolyzed cellulosic material with alkaline cooking liquor containing sodium sulfide and sodium hydroxide.

2. The method according to claim 1, wherein said neutralization is carried out in 10-40 minutes.

3. The method according to claim 1 or 2, wherein said neutralization is carried out in 20-30 minutes.

4. The method according to claim 1, 2 or 3, wherein neutralized hydrolysate is removed from said digester by displacing with spent cooking liquor.

5. The method according to claim 4, wherein said spent cooking liquor has a residual alkali concentration of 10-20 g effective NaOH/l.

6. The method according to claim 4 or 5, wherein said spent

cooking liquor has a temperature between 150-180°C.

7. The method according to any one of claims 4 to 6, wherein said neutralized material is subjected before said delignification to a pretreatment reaction, in which said spent cooking liquor reacts with said neutralized material under alkaline conditions over pH 9.

8. The method according to claim 7, wherein in said pretreatment reaction, said spent cooking liquor reacts with said neutralized material at a temperature of 150-180°C for 10-30 minutes.

9. A method according to any one of claims 1-8 including removing a portion of said hydrolysate from said digester prior to said neutralizing step.

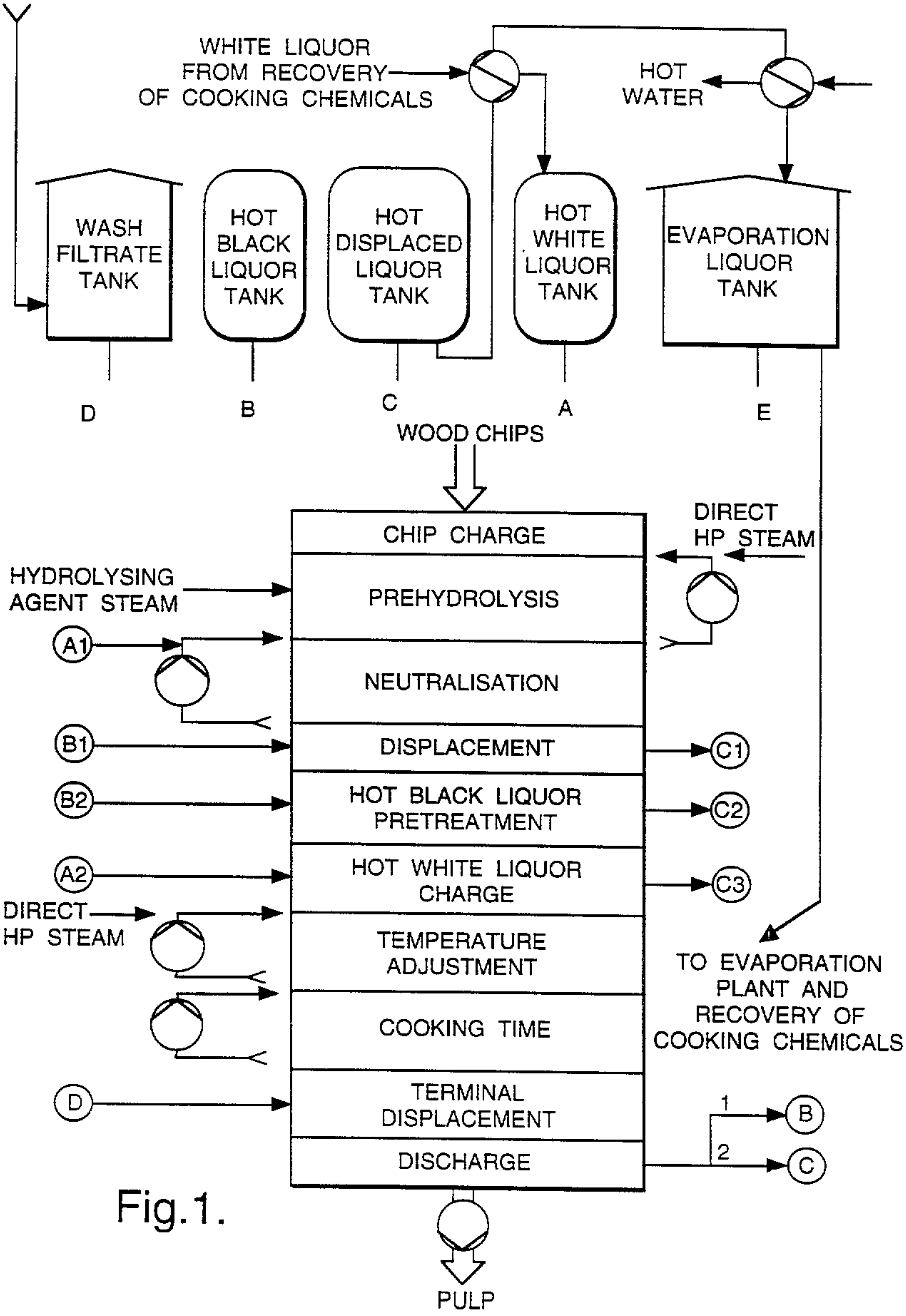

WHITE LIQUOR
FROM RECOVERY
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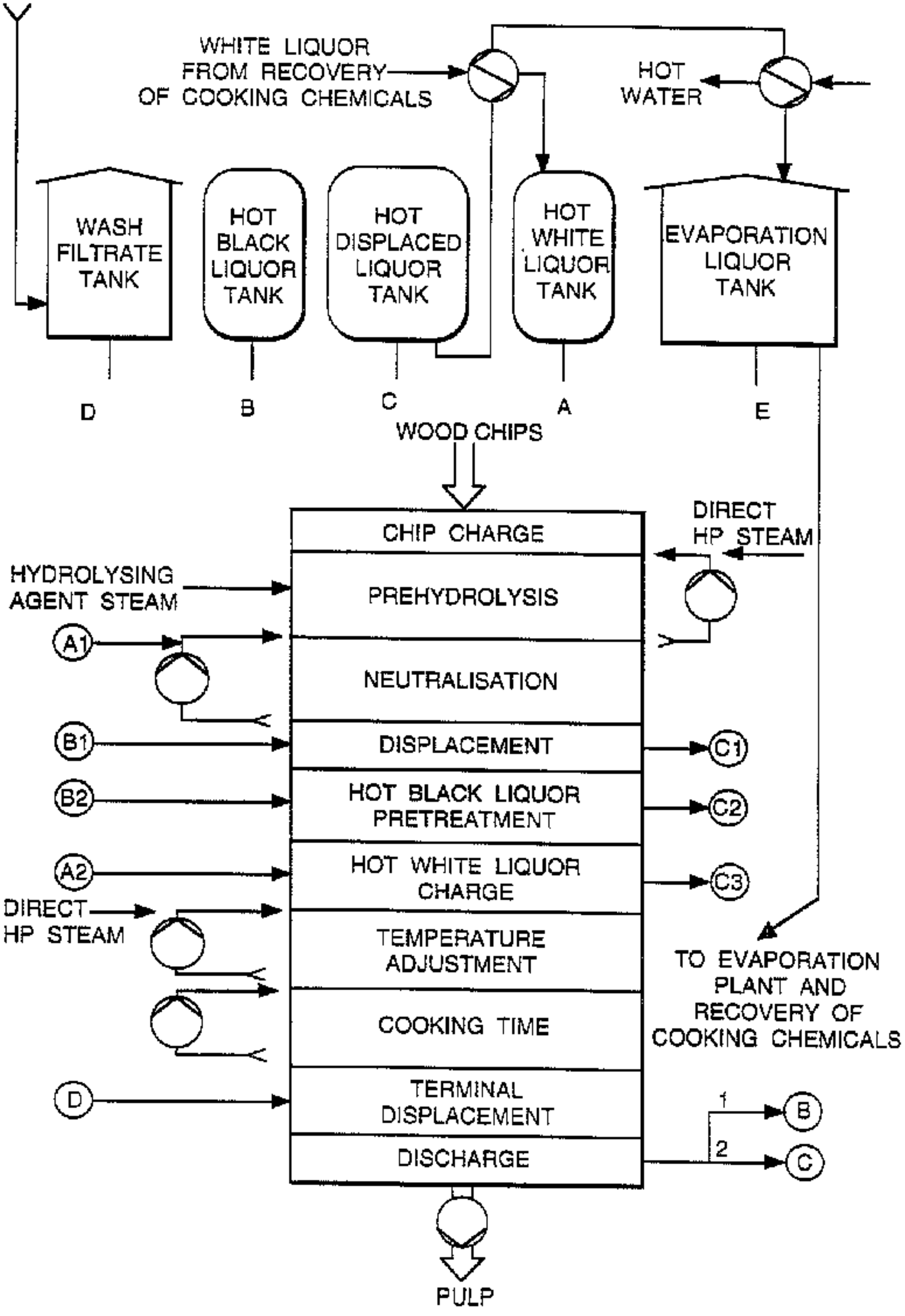
Fig.1.


WHITE LIQUOR FROM RECOVERY OF COOKING CHEMICALS
HOT WATER
WASH FILTRATE TANK
HOT BLACK LIQUOR TANK
HOT DISPLACED LIQUOR TANK
HOT WHITE LIQUOR TANK
EVAPORATION LIQUOR TANK
D
B
C
A
E
WOOD CHIPS
CHIP CHARGE
DIRECT HP STEAM
HYDROLYSING AGENT STEAM
PREHYDROLYSIS
A1
NEUTRALISATION
B1
DISPLACEMENT
C1
B2
HOT BLACK LIQUOR PRETREATMENT
C2
A2
HOT WHITE LIQUOR CHARGE
C3
DIRECT HP STEAM
TEMPERATURE ADJUSTMENT
TO EVAPORATION PLANT AND RECOVERY OF COOKING CHEMICALS
COOKING TIME
D
TERMINAL DISPLACEMENT
1
B
2
C
DISCHARGE
PULP