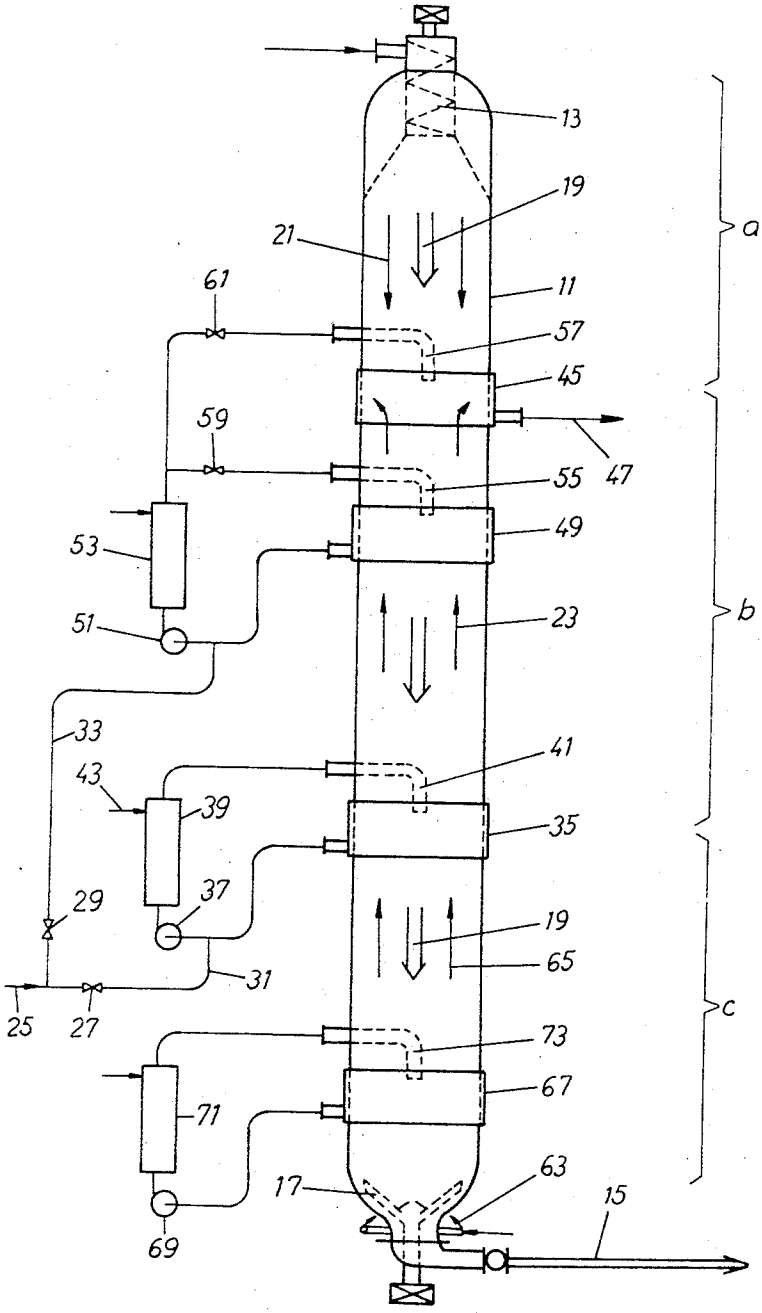
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METHOD OF PERFORMING COUNTER-CURRENT CONTINUOUS CELLULOSE DIGESTION

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METHOD OF PERFORMING COUNTER-CURRENT CONTINUOUS CELLULOSE DIGESTION

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ABSTRACT OF THE DISCLOSURE

There is provided an improved process and apparatus for digesting cellulosic fiber materials. the materials are passed through a elongated digester which has provisions for a final wash of the digested materials prior to discharge. Digesting liquor is passed through the digester counter-currently with respect to the materials. The improvement resides in the use of a plurality of inlets for the total digesting liquor and wherein the inlets are disposed along the digesting zone at mutually different axial distances from the material discharge end of the digester. The amount of digesting liquor passed through the respective inlets is so controlled that the concentration of the digesting liquor in the digesting zone is less near the material discharge end of the digester than near the material entrance end of the digester.

The present invention relates to a method of performing cellulose digestion, in which wood chips or other comminuted cellulosic fiber material is fed continuously from one end to the other of an elongated digester while digesting said material in a digesting zone by means of digesting liquor, e.g., sulphate liquor, which is continuously supplied to the digester and is driven counter-currently to the fiber material during the passage thereof through the digesting zone and which liquor is discharged from the digester by being strained off the fiber material, and in which the greater part of the digesting liquor is washed out of the fiber material before the discharge thereof from the digester, by means of a washing liquid driven counter-currently to the fiber material.

In comparison to concurrent digestion, in which the digesting liquor is fed in the same direction as the fiber material through the digester and the spent digesting liquor departs from the digester together with the digested fiber material, the above-mentioned counter-current digestion has the advantage, that it can be combined in an advantageous manner with a preliminary wash, whereby the fiber material is relieved of spent digesting liquor and dissolved reaction products. However, the counter-current digestion has poved to involve the disadvantage of dissolving pentosans to a considerably higher extent than in concurrent digestion. Trials on mill scale gave a pentosan content of merely 4 to 5 percent in pulp digested according to the counter-current method, whereas pulp digested according to the concurrent method contained 8 to 9 percent pentosans, the alkali consumption and other conditions being the same. The increased pentosan dissolution involves a decreased pulp yield and therefore a lower economic result of the counter-current digesting method.

In all probability the increased pentosan dissolution is due to the high concentration of alkali in the final phase of the digestion, when performed in counter-current. The conditions are quite different in concurrent digestion, because there about 65 to 75 percent of the active chemicals supplied are consumed already before the full digesting

temperature is reached, viz. for dissolution of the easily dissolvable hemicelluloses, whereas only a smaller amount, about 25 percent, of the chemicals supplied are consumed for the delignification which takes place at the full digesting temperature. Thus, in a normal concurrent digestion where white liquor and wood have no appreciable relative movements, the concentration of active alkali has dropped already when reaching the digesting zone to a value of about 25 percent of the original value and then drops further, so that the alkali is almost completely spent at the end of the digesting zone.

In counter-current digestion the total requirements of digesting liquor has previously been supplied to the end of the digesting zone where the dissolvable hemicelluloses have already been dissolved and the wood is delignified. Therefore, during the passage of the digesting liquor in counter-current to the wood, any appreciable consumption of active alkali will not take place to begin with, and over a great length of the digesting zone the alkali concentration is maintained at at high value. At the beginning of the digesting zone where the digesting liquor encounters the wood, the wood still contains most of its hemicelluloses, and a rapid reaction will take place therebetween the digesting liquor and the wood so that the concentration of alkali of the liquor drops sharply.

The object of the present invention is to improve the above-mentioned method of counter-current digestion and to effect a reduction of the cencentration of the digesting liquor at the end of the digesting zone, so that the above-mentioned tendency to detrimental dissolution of pentosans is eliminated or at least counter-acted. According to the invention said object is obtained by distributing the digesting liquor supply over the digesting zone in the longitudinal direction of the digester.

The invention also relates to a cellulose digester adapted for carrying out the above-mentioned method and which is of the kind consisting of an elongated, preferably cylindrical, pressure-resistant container which is provided at one end with means for continuously charging comminuted cellulosic fiber material, such as wood chips, thereinto and is provided at the other end with means for discharging digested fiber material therefrom, and which container is provided with inlets for digesting liquor and wash liquid and with a sieve girdle for straining off spent digesting liquor from the fiber material, the inlets for digesting liquor and wash liquid being positioned downstream of said sieve girdle as related to the direction of feed of the fiber material. The essential inventive feature of said digester consists in that two or more digesting liquor inlets located between the sieve girdle and the wash liquid inlet, are placed at mutually different axial distances from the fiber material discharging end of the digester.

An embodiment of the invention relating to sulphate digestion of kraft pulp will be more closely described hereinbelow with reference to the accompanying diagrammatic drawing.

In the drawing, **11** designates an upright cylindrical pressure-resistant container of a substantially uniform cross-sectional area and a length of the order of ten times the diameter. At its upper end the container is provided with a feeding device **13**, by means of which a comminuted cellulosic fiber material, such as wood chips, is introduced into the container either fully continuously or batchwise as small successive batches. The fiber material moves as a solid column vertically downwards through the container and is discharged at its lower end into a conduit **15** by means of a discharging device **17** which may comprise a rotary scraper. The direction of movement of the fiber material is designated by double arrows **19**. During its passage through the container the fiber material is subjected to various treatments which

are concentrated each to a separate zone *a*, *b* and *c*, respectively.

In the first, comparatively short zone *a* a preliminary heating takes place of the fiber material and of the liquid introduced therewith, which may consist of water or diluted black liquor. Said liquid moves downwardly at substantially the same rate as the fiber material, as is indicated by the single arrows **21**.

In the following zone *b*, the digesting zone, a fiber-liberating digestion of the fiber material is performed by means of sulphate liquor which is driven counter-currently to the fiber material, as indicated by the single arrows **23**. The total white liquor quantity required for the digestion is supplied through a conduit **25** and is distributed by means of control valves **27**, **29** upon the conduits **31** and **33**, respectively. The conduit **31** is connected to and feeds liquor into a circulation loop comprising a sieve girdle **35** inserted in the shell of the container, a pump **37**, a heating device **39** and an inlet tube **41** located on the axis of the container and having its open end located at the level of the sieve girdle **35** or somewhat above the same. In said circulation loop the liquor supplied through the conduit **31** is brought to circulate whereby the same is spread from the inlet **41** radially outwards in all directions and thereby is thoroughly distributed over the whole cross-section of the part of the chips column located opposite the sieve girdle **35**. The liquor, which in the heating device **39** has been heated to a temperature of approximately 175° C. by means of steam supplied through a conduit **43**, moves upwardly through the chips column, while dissolving the lignin of the wood material, towards a sieve girdle **45** inserted in the shell of the container and located at a comparatively small distance from its upper end. Black liquor departs through said sieve girdle **45** and is carried through the conduit **47** to a plant for recovery of the alkali contents thereof. The temperature of the digester at the level of the sieve girdle **45** may be approximately 150° C.

The white liquor conduit **33** is connected to and feeds liquor into a second circulation loop comprising a sieve girdle **49** inserted in the shell of the container, a pump **51**, a heating device **53** and an inlet tube **55** located on the axis of the container and having its open end located at the level of the sieve girdle **49** or somewhat above the same. The sieve girdle **49** is positioned between the sieve girdles **45** and **35**, preferably considerably closer to the first-mentioned. The liquor portion supplied through the conduit **33** is spread from the end of the inlet tube **55** radially outwards and is evenly distributed over the cross-section of the chips column so that the alkali strength of the liquor flowing upwardly through the chips column towards the sieve girdle **45**, is raised when moving past the sieve girdle **49**. A further addition of liquor may take place approximately at the level of the discharge sieve **45**, through a central inlet tube **57** connected to the exit side of the heating device **53**. The proportions of liquor supplied to the inlets **55** and **57** can be controlled by means of valves **59**, **61**, or one of them may be shut off, if desired. According to a modification, the circulation loop **49**, **51**, **53**, **55** may be omitted, the inlet **57** being connected via a control valve to the heating device **39**.

The described liquor supply conduits and control valves make it possible to supply the liquor at various levels of the digesting zone in order to obtain a desired suitable concentration gradient along the axial extension of the digesting zone. Thus a smaller part of the total liquor requirements is usually supplied through the inlet **41**, the concentration at the end of the digesting zone thus being held comparatively low. The greater part of the total liquor quantity is supplied through the inlets **55** and/or **57** at the beginning of the digesting zone, where the requirement is greater with regard to the great consumption of alkali needed for the dissolution of the hemicelluloses. When distributing the liquor it should be observed, however, that a certain minimum concentration be maintained over the entire length of the digesting zone, else the desired delignification rate will not be reached.

In the lowermost zone *c*, washing of the completely digested fiber material takes place by means of wash liquid which usually consists of water or filtrate coming from a subsequent filter washing device and containing traces of black liquor. Said wash liquid is supplied through spray nozzles **63** distributed around the pulp outlet end of the container. A certain part of said liquid, which also has a cooling effect, accompanies the pulp out of the container, and an other part thereof is forced upwardly through the pulp column, as indicated by the arrows **65**, and is displacing the digesting liquor upwardly. The wash liquid is heated in a circulation loop comprising the sieve girdle **67**, the pump **69**, the steam heating device **71** and the central inlet tube **73**.

By supplying merely a part of the liquor required for the digestion to the lower part of the digesting zone *b*, the wash of the pulp in the digester will also be more efficient. The highly concentrated liquor present in the upper part of the digesting zone is displaced upwardly by the weaker liquor supplied further down and consequently there remains only a smaller amount of liquor that has to be displaced by the wash water in the washing zone *c*.

Of course, the above described embodiment can be modified in various respects without departing from the scope of the invention as set forth in the following claims. Thus, the distribution in the axial direction of the digester, of the liquor supplied to the digesting zone may be realized by means of a plurality of orifices upon one and the same liquor supply tube inserted in the digester. The various liquor portions may be heated to the desired temperatures in equal or different manners, such as by means of heat exchangers or by injection of steam into liquor conduits or directly into the digester. The counter-current digestion as described above can be preceded by any chemical treatment performed in the same container, e.g., a preliminary digesting stage with a treating liquid flowing counter-currently or concurrently to the fiber material.

I claim:

1. In a method of performing cellulose digestion of cellulosic fiber materials wherein comminuted cellulosic fiber material is fed continuously from one end to the other end of an elongated digester and said material is digested in a digesting zone within said elongated digester by means of digesting liquor which is continuously supplied to the digester and which liquor is discharged from the digester by being strained off the fiber material, and in which the greater part of the digesting liquor is washed out of the fiber material before the discharge thereof from the digester, by means of a washing liquid driven counter-currently to the fiber material, supplying the digesting liquor to the digesting zone at a plurality of inlets which are distributed over the digesting zone in the longitudinal direction of the digester, the composition of the digesting liquor supplied at any one inlet being substantially the same as supplied at any of the other inlets, the improvement comprising flowing the digesting liquor counter-currently with respect to the movement of the cellulosic fiber material, and passing a smaller amount of the digesting liquor through at least one inlet to the digesting zone located near the end of the digesting zone adjacent the cellulosic material discharge end of the digester than the amount of the digesting liquor passed through at least one inlet to the digesting zone located near the end of the digesting zone adjacent the cellulosic material entrance end of the digester, whereby the concentration of the digesting liquor near the discharge end of the digesting zone is less than the concentration near the entrance end of the digesting zone.

2. The process of claim **1** wherein the amount of digesting liquor passing through each of the plurality of inlets is controlled to produce a concentration gradient along the axial extension of the digesting zone with the greater con-

centration of digesting liquor being at the end of the digesting zone adjacent the cellulosic material entrance of the digester.

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