METHOD AND ARRANGEMENT FOR WASHING AND COOLING AT THE OUTLET END OF A CONTINUOUS CELLULOSE DIGESTER

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The invention relates to a method and apparatus for performing, in an elongated cellulose digester wherein a fibrous material during its continuous feed in the longitudinal direction of the digester is digested by cooking with a digesting liquor at high pressure and high temperature, a washing and cooling operation of the fibrous material as well as before the same is discharged through an outlet at one end of the digester, usually in connection with relieving of at least the greater part of the digesting pressure.

For this purpose it is known to supply close to the digester outlet a liquid, such as for instance, water or filtrate containing digesting liquor residues, which liquid is brought to flow in counter-current to the fibrous material, thereby cooling the fibrous material as well as washing digesting liquor out of the same. Then the liquid supplied at the digester outlet generally is of a comparatively low temperature in order to cause an effective cooling of the fibrous material, and therefore the washing operation will also take place at a low temperature.

However, in order to bring about an efficient washing a high temperature is required, because it is important not only to displace the digesting liquor and products dissolved thereby out of the spaces between the fibre bundles, but also to remove the chemicals from the finer pores of the material which can only be obtained by diffusion and therefore is favoured by a high temperature.

The object of the invention is to provide an efficient cooling as well as an efficient washing at the fibrous material at the outlet end of the digester. In order to attain said object there is performed according to the invention a washing operation at a distance from the digester outlet by means of liquid which, exteriorly of the digester, is heated to a higher temperature than the temperature of the liquid supplied to the digester closer to its outlet for cooling purposes. Preferably, one and the same liquid quantity is used first for cooling and then after being heated, for washing of the fibrous material, and according to a secondary feature of the invention said object is realized whereby that liquid screened off the fibrous material and containing such liquid as consists of, or has been displaced by, the liquid supplied closer to the digester outlet for cooling purposes, is heated exteriorly of the digester and is returned to the same as washing liquid.

The liquid taken out of the digester in order to be returned thereto after being heated, can also contain liquid which already has passed out or more times through the fibrous material in order to wash the same, and thus a loop is formed in which the liquid circulates, so that the same liquid quantity is brought to pass through the fibrous material repeatedly in one and the same path and between each such passage is heated in the part of the loop located exteriorly of the digester. Preferably, the heating of the liquid supplied or returned to the digester for washing purposes is performed by exchanging heat with spent digesting liquor taken out of the digester.

The invention will be more closely described hereinbelow with reference to the accompanying drawing which diagrammatically shows an illustrative embodiment of a continuous cooking plant to which the invention is applied.

In the drawing, 11 designates a steam vessel in which wood chips or other finely comminuted cellulose material supplied through a low pressure rotary valve 15 is heated by low pressure steam supplied through the conduit 17 while the material is agitated and fed towards the outlet end of the steaming vessel by means of a feeding screw 19. The desired overpressure, approximately 1 atmosphere gauge, is maintained by means of a automatic control valve 21. Suitable digesting liquor, such as sodium lye, is supplied through the tube connection 22. The mixture of lye and chips is introduced into the upper end of an upright cylindrical digester 25 by means of a high pressure rotary valve 23, and the mixture is heated by steam which is supplied from the bottom of the digester, partly through the rotary valve 23 in order to assist in emptying thereof, partly directly to the digester top and in a quantity controlled by the pressure therein. Further heating of the lye-chips mixture is effected by a circulation loop, comprising two alternately connected sieve girdles 35, 37 inserted in the digester wall, a pump 39, a heat exchanger 41 and a return conduit 43. This conduit, which is arranged centrally in the digester and has its lower end located at the centre of the digester cross-section and preferably somewhat above the level of the sieve girdle 35, re-enters into the circulation loop by drawing lye drawn off through the sieve girdles and heated in the heat exchanger. The circulating lye is heated to a temperature of approximately 170° C., and in the digester there is maintained a hydraulic pressure of the order of 10 atmospheres. During the slow and even descent of the fibre material through the digester it resists with the digesting liquor, so that the fibrous material is completely digested when it reaches the level of the sieve girdle 53, inserted into the digester wall and located at a considerable distance from the outlet end of the digester, for instance at a distance from the lower end of the digester equal approximately to a third of the length of the digester. In the remaining bottom part of the digester the fibrous material is washed and cooled in a manner to be more completely described below, so that the fibrous material is almost completely relieved of digesting liquor and dissolved chemicals and has a considerably reduced temperature when it reaches the extreme lower end of the digester. There, the material is fed down into a centrally located outlet 45 by means of a motor-driven scraping or agitating device 47 and is transferred through a conduit 49 to a blow tank 44 in which atmospheric pressure or a low overpressure is maintained. Due to the pressure drop a certain steam quantity is given off, particularly if in spite of the cooling at the digester outlet the material is still of a temperature above 100° C. Said steam is discharged through an outlet 46 at the top of the blow tank, whereas the pulp is discharged through a bottom outlet 48 and is carried through a conduit which is connected thereto and into which is inserted a valve 50, controlled by the level of pulp in the blow tank, to the pulp vat 52 of a rotary suction filter. Taken up on the rotary sieve drum 54 of said filter is a pulp layer 56 which is washed by washing water, e.g., warm or cold fresh water supplied by the compact nozzle 58. A part of this washing water, consisting of wash water and digesting liquor residues is collected in a container 60 from where it is returned by means of a pump 65 through the conduit 51 to the digester and is used therein in order to effect in accordance with the invention and in a manner to be more closely described hereinbelow, a cooling operation at the outlet and a first washing of digesting liquor out of the pulp already in the bottom part of the digester.

The sieve girdle 53, consisting of a perforated or slitted cylindrical sieve plate, is flush with the cylindrical wall.
of the digester, and outside of the sieve plate the digester wall is widened so that a collecting space 55 is formed for spent digesting liquor screened off the fibre material making past the sieve. This collecting space is connected to the conduits 56 and 57, so that heat is exchanged between the hot digesting liquor passing through the conduit 57 and the washing liquid passing through the conduit 90. Cooling liquid which has been supplied to the digester through the ejection holes 89 on the scraping or agitating device 47 and which penetrates upwardly through the fibre material, comes out through the sieve girdle 86 and is caused by the pump 92 to flow through the heat exchanger 94 wherein it is heated to a temperature considerably above 100° C., for instance 130° C., whereupon the liquid is returned to the digester via the tube 96, wherein it is spread from the orifice of the tube 96 radially in all directions. In the described circulation loop the liquid is caused to recirculate repeatedly before it is driven upwardly through the chip column towards the sieve girdle 53. In this manner there is effected at the level of the sieve girdle 86 an efficient and thorough heating of the fibre material to the high temperature mentioned, so that the washing operation of the fibre material in the bottom end of the digester, on account of the diffusion of the chemicals from the interior of the fibre bundles out into the surrounding liquid being facilitated by the raised temperature, takes place considerably quicker and more efficiently than if the washing liquid were supplied through a hole 90 and been driven directly upwards towards the sieve girdle 53.

Immediately below the sieve girdle 53 there is arranged a similar sieve girdle 98. Liquid screened off through the same is driven by a pump 100 through an exterior circulation conduit 102 and an interior conduit 104 connected thereto and extending along the axis of the digester, back to the digester and is spread from the orifice of said last-mentioned conduit radially in all directions approximately at the level of the sieves 53, 98. This transverse circulation of washing liquid through the chip column serves to equalize the concentration of digesting liquor over the digester cross-section, so that the least possible amount of digesting liquor remains in the corner spaces of the material when the same enters the zone between the sieve girdles 98 and 86 where diffusion washing takes place. During its motion upwardly through the chip column in this part of the digester, the washing liquid is enriched with the chemicals extracted by diffusion. As already mentioned the washing liquid finally departs through the sieve girdle 53 together with the digesting liquor accompanying the chips and being displaced by the washing liquid.

The above-described embodiment is illustrative of a preferred form of the invention. It is not intended to limit the possibility of insuring the features of improved washing and cooling at the outlet end of the digester. The arrangement disclosed herein is an example of apparatus in which the invention features of the disclosure may be utilized, and it will become apparent to one skilled in the art that certain modifications may be made within the spirit of the invention as defined by the appended claims.

What is claimed is:

1. In a method of liberating cellulosic fibrous material by digestion thereof with a digesting liquor at a high pressure and a high temperature in a continuous digester having a fibrous material inlet, a washing liquid inlet, and a fibrous material outlet, the improvement of washing the fibrous material counter-current to the flow thereof and immediately before the same is discharged through the outlet, comprising supplying cooling liquid to the digester close to the outlet, screening off the liquid in the fibrous material, washing liquid, heating said screened off liquids exteriorly of the digester, returning the heated liquid as a washing liquid to the digester at a greater distance from the digester outlet than the cooling liquid is supplied and heating said washing liquid by exchanging with digesting liquid that is discharged from the digester before introducing the washing liquid.

2. In an apparatus for liberating cellulosic fibrous material by digestion thereof in a longitudinal cellulosic digester with a digesting liquor at a high temperature
and a high pressure and adapted such that the fibrous material will be continuously fed in the longitudinal direction of the digester, said apparatus having a fibrous material inlet, a digesting liquor inlet and an outlet for digested fibrous material, and said apparatus including means for heating said digesting liquor, the improvement which comprises providing said apparatus with a cooling liquid inlet positioned close to said outlet, a sieve girdle in said digester for screening off spent digesting liquor from the fibrous material, a sieve girdle between said cooling liquid inlet and said spent digesting liquor sieve girdle for screening off said cooling liquid, a second heating device exterior of the digester, a conduit connected to said cooling liquid sieve girdle, said conduit passing through said second heating device and returning to the digester, an orifice in said conduit within said digester between said cooling liquid inlet and said spent digesting liquor sieve girdle, said apparatus being adapted such that cooling liquid supplied through said cooling liquid inlet first cools the fibrous material and then washes it at a raised temperature.

3. An apparatus as set forth in claim 2 in which said second heating device comprises a heat exchanger connected to said spent digesting liquid sieve girdle and to said cooling liquid sieve girdle for heating said cooling liquid with heat exchanged from the spent digesting fluid.

4. An apparatus as set forth in claim 2 further comprising a sieve girdle for screening off used washing liquid and means for recirculating said used washing liquid to the digester for further use in washing the fibrous material.

5. An apparatus as set forth in claim 4 further comprising a sieve girdle disposed in said digester at a location upstream of said used washing liquid sieve girdle for screening off and finally discharging used washing liquid from the digester.

6. An apparatus as set forth in claim 4 further comprising means for driving said recirculating washing liquid radially outward from a central orifice of a conduit disposed within the digester and upstream of said used washing liquid sieve girdle.

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