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2,916,346

METHOD FOR CHEMICAL TREATMENT OF SUSPENDED SOLIDS

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3 Claims. (Cl. 8—156)

The present invention relates generally to the art of treating suspended solids, and relates more specifically to an improved method of carrying out in a continuous flow operation the chemical reaction phase of any process, whether in single- or multi-stage, for refining or purifying suspended solids.

It is an object of this invention to provide an improved method of effecting a continuous counter current treatment of a fibre suspension with a chemical reagent, solvent, washing liquid or other fluid medium so as to produce an effect which by application of prior art methods could be produced only in several successive treatments. It is to be understood that herein counter current treatment of a fibre suspension implies flowing suspended solids in a direction opposite to that of the fluid medium encircling said solids, said fluid medium being any chemical or solvent in solution or liquid form, or even wash water.

This and other specific objects and advantages of the invention will be apparent from the following detailed description.

A clear conception of the several steps constituting my improved method of treating fibrous material, and one specific type of apparatus described in my co-pending application, Serial No. 324,934, filed December 12, 1952, now Patent No. 2,802,572, for carrying on the method commercially, may be had by referring to the drawing accompanying and forming a part of this specification, in which:

Fig. 1 is a schematic vertical axial section taken through the apparatus.

Fig. 2 is a diagrammatic view of the reaction run.

This invention is applicable wherever a mass of divided solids is to be subjected to the action of a chemical in solution or to any chemicals or solvents in liquid form. The present continuous method is directed specifically to bleaching and rinsing and any chemical treatment of cellulosic pulps and other short staple materials.

The basic operation in the bleaching of cellulosic pulps consists in treating a slurry, consisting essentially of the fibrous material and of water, with a chemical agent, and then washing the fibrous material free from the products of the chemical reaction.

Bleaching operations are either continuous or intermittent and are characterized by a series of different chemical treatment stages following one after another in series and ordinarily having a rinsing phase interposed between successive treatment stages. In order that the action of a certain chemical be as effective as possible, treatment with this chemical is divided into several, customarily two, stages. Because both stages are followed by a rinsing phase it follows that a two-stage treatment system involving one and the same chemical comprises altogether four stages including rinsing.

Bleaching towers with attendant washers as also the equipment for transporting the pulp between stages or phases and delivering it to or receiving it from the towers

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and/or the washers are inordinately costly installations. It is the object of the present invention to provide a method wherein the two stages such as a chemical treatment and subsequent rinsing, or the four stages, e.g., double chemical treatment plus two rinsings can be carried out in one and the same reaction tower as successive, simultaneously occurring and continuous stages. Because the flow of chemicals is counter-current to the flow of pulp to be treated, one single treatment of the kind to be described corresponds in efficiency to numerous successive prior art treatment stages.

Fig. 1 shows one embodiment of an apparatus for carrying out my improved method which has been successfully applied to commercial operation but details of construction of the apparatus form no part of this invention. Reference numeral 1 designates a treatment tower having a false bottom 2 which divides the tower interior into a main chamber M with a discharge outlet 11 for treated pulp and a drain chamber 3 under smaller pressure than that, which prevails in chamber M against false bottom, and with a discharge outlet 4. The false bottom is so perforated that fibres from the main chamber cannot escape therethrough into the drain chamber 3. A shaft 5 extends axially of the tower 1 and is driven in any suitable manner. Extending radially from the shaft 5 is an agitator which comprises arms 7 that terminate at places adjacent the inner surface of the tank wall and are disposed one above the other along the length of the shaft and adapted to mix the liquid chemicals and pulp slurry. A scraper arm 6 is mounted at the lower end of the shaft 5 close to the false bottom 2 and operates to clear the false bottom of clogging fibres and to help in moving the incoming pulp slurry from pulp inlet 8 onto said false bottom. Suitably spaced from the perforated false bottom 2 is a supply pipe 9 for chemical reagents, e.g., bleaching solution. A wash water inlet pipe 10 is arranged above said chemicals supplying pipe 9, at the top of the tower, substantially on a level with the treated pulp discharge outlet 11. Moreover, a suitable paddle means is mounted at the top end of the shaft 5 to force treated pulp out of the discharge outlet 11.

Referring now to Fig. 2, point A corresponds to the perforated false bottom of Fig. 1, i.e., the point where pulp slurry is introduced into the main chamber M of the treating tower. B, C and D correspond to points 9, 11 and 10 of Fig. 1 for bleach supply, treated pulp discharge and wash water inlet, respectively. Dash line e represents the reactivity of the pulp, while arrows 12 and 13 respectively illustrate the direction of movement of the added chemicals and of the pulp. Dash line f represents changes in bleach concentration under one and the same conditions. Wash water flow is indicated by dotted arrows 14.

Now, to effect uniform and combined bleaching and rinsing of pulp in one continuous flow operation, the improved method is carried out as follows:

Pulp slurry under pressure is introduced through the pipe shaft end 8 into the main chamber M of the tower. Then, as smaller pressure prevails in the drain chamber 3, a part of the suspension liquid drains through the perforated false bottom 2 into the chamber 3 and is conducted away by the discharge pipe 4. Therefore, the pulp slurry will thicken on the upper surface of the perforated false bottom and, given travelling energy by the scraper arm and the pulp slurry under pressure and continuously incoming through pipe 8, the thickened pulp slurry will rise towards the discharge opening 11. Into this thickened mass of rising pulp is admitted at suitable points, bleaching solution by way of pipe 9, and then wash water through pipe 10. In the top part of

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the tower the agitator arms 7 carry out uniform mixing of pulp slurry and bleach and uniform mixing of bleaching pulp and rinsing water, and the wash water flowing downwardly through the mass of thickened pulp into the drain chamber frees the fibres from the products of the chemical reaction in the upper part of the main chamber. Then, on further downward flow, the wash water mixes with the bleaching solution introduced through pipe 9. Upon reaching the perforated false bottom 2 the wash water is practically exhausted of its bleach content and passes through bottom 2 into the drain chamber 3. As shown in Fig. 2, the concentration of added bleach is highest at the bleach supply inlet level B, and, in consequence of the chemical reaction between the pulp and the bleach, said concentration drops the lower the more the pulp slurry inlet is neared, as clearly shown by dash line *f*. Further, Fig. 2 shows that the chemical reactivity of the pulp is greatest at the pulp slurry inlet level A and diminishes towards level B, as shown by dash line *e*. At level B' the bleaching phase proper must be regarded as completed and the downwardly flowing wash water admitted at D takes up the part of bleach carried by the pulp travelling towards its discharge outlet C.

From the foregoing description of the successive steps of the improved method, it should be apparent that the present invention provides a method of most effectively bleaching and washing fibrous material in a continuous manner and while the fibre stock is travelling along a path counter current to the treating liquid and under agitation. With the aid of a relatively simple and durable apparatus the improved method can be carried out automatically. The present improved method has proved highly successful in actual commercial use and produced the desired results with maximum chemical efficiency and low cost. These advantages result from the facts that: (1) concentrated bleaching solution chiefly affects already chemically treated, i.e., bleached pulp and thus insures maximum completion of reaction, i.e., proper bleaching; (2) diluted liquid chemical, i.e., bleaching solution flows through layers of chemically untreated pulp and thus insures proper consumption of chemicals, i.e., bleach; (3) reaction velocity is easily controlled by regulating the amount and temperature of wash water; (4) continuous bleaching operation combined with complete counter current washing operation takes place within one and the same treating tower and (5) further disposal and handling of drained liquid is easy because only

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small amounts of wash water are required for washing the pulp and carrying the bleach.

It should be understood that it is not desired to limit this invention to the precise steps of the method, herein shown and described, but is to include various modifications within the scope of the claims which may occur to persons skilled in the art.

What I claim is:

1. In a method for the continuous treatment of wood pulp, in combination, the steps of continuously introducing a liquid suspension of wood pulp into the lower portion of a reaction vessel so that wood pulp during its introduction pushes against the wood pulp already introduced into said vessel and moves such wood pulp upwardly within said vessel; introducing a liquid reagent for the treatment of said wood pulp into said reaction vessel at a level above the level of introduction of the liquid suspension of wood pulp; removing liquid from said reaction vessel at a point below the level of introduction of said suspension so as to permit said liquid reagent to move downwardly in said vessel so as to treat in countercurrent the upwardly moving pulp; and washing the thus reagent-treated wood pulp in said reaction vessel at a level above said level of introduction of said liquid reagent with a washing liquid introduced into said reaction vessel at a level above said level of introduction of said liquid reagent and moving downwardly in countercurrent direction to the upward movement of said reagent-treated wood pulp, whereby the wood pulp originally introduced into said reaction vessel is chemically treated and washed in the same reaction vessel.

2. A method for the continuous treatment of wood pulp as defined in claim 1, including the step of removing said chemically treated and washed wood pulp from said reaction vessel at a level above said level of introduction of said liquid reagent.

3. A method for the continuous treatment of wood pulp as defined in claim 1, wherein liquid is removed from said reaction vessel at a point below the level of introduction of said suspension by suction.

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