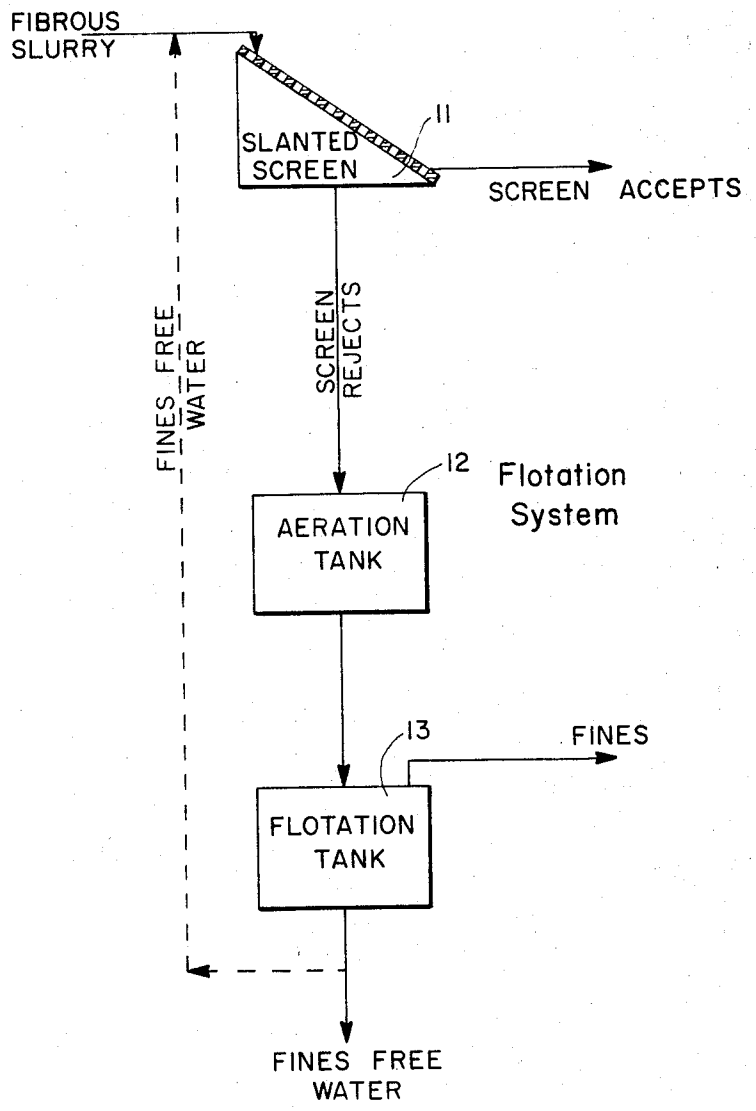
April 29, 1969 J. B. SISSON ET AL 3,441,130

PROCESS FOR THE REMOVAL OF FINES FROM WOOD PULP FIBERS

Filed Nov. 30, 1967 Sheet 1 of 2

Fig. 1



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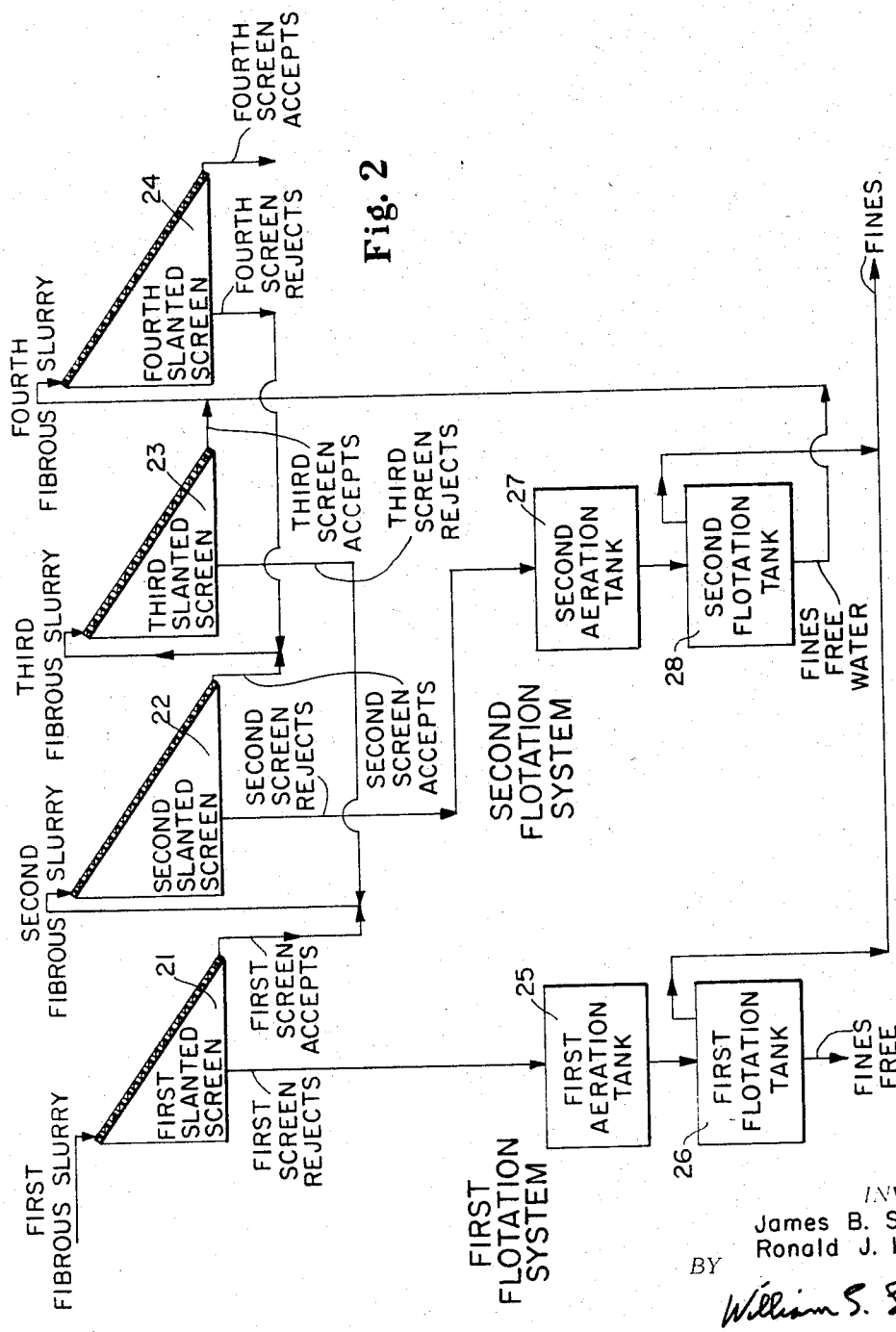


Fig. 2

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3,441,130

PROCESS FOR THE REMOVAL OF FINES FROM WOOD PULP FIBERS

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U.S. Cl. 209—2 6 Claims

ABSTRACT OF THE DISCLOSURE

Process for removing fines from wood pulp fiber slurry prior to papermaking operations includes screening the slurry on a thin perforated metal sheet to separate fines-containing slurry from the feed. The fines are then separated from the fines-containing slurry in an aeration and flotation process using spent sulphite liquor solids under specified conditions.

Background of the invention

This invention relates to improvements in papermaking and water pollution control operations and to the provision of a fines removal and water recovery process which contributes to the efficiency of papermaking processes. More particularly, the invention provides an improved fines removal process for use in treating wood pulp fiber slurries prior to subsequent papermaking operations.

In one specific embodiment the invention comprises thin perforated metal plate screening media operating in conjunction with improved flotation processes to remove fines from unbleached sulphite wood pulp slurries prior to bleaching treatments. In another specific embodiment the improved fines removal process is applied to repulped broke wood pulp fibers to remove fines prior to sheet formation.

In referring to the fines associated with an unbleached wood pulp fibrous slurry herein, applicants intend reference to small woody fibers which are capable of passing through a 150 mesh screen and whose diminutive size and high pitch and resin content result in serious reductions in product absorbency and in sheet dryability, as measures of pulp quality. The fines removed by the present process also increase bleaching chemical consumption when they are allowed to remain in unbleached wood pulp slurries in subsequent bleaching operations. The removal of fines is particularly beneficial in reducing the problems related to the collection of pitch on the rolls, carrier fabrics, wires and steam drums of paper machines when operating with unseasoned or green wood. In the case of acid sulphite pulps produced from northern hardwoods, for example, the fines are predominantly small woody fibers, known as ray or parenchyma cells, which small woody fibers contain a predominant percentage of the pitch found in unbleached slurries of these wood fibers.

Although the screening and flotation steps comprising the fines removal process disclosed herein are primarily described in terms of application to unbleached sulphite wood pulp slurries, those skilled in the papermaking arts will recognize the advantages of applying the process to slurries of bleached fibers. Bleached fibers of particular interest result from the repulping of deckle trim and other recycled paper in a papermaking process; these bleached fibers are referred to collectively as broke. In broke slurries the fines are broken fiber fragments and hydrated fiber fragments or fibrils whose presence results in a filled or loaded paper exhibiting the characteristics of reduced dryability and absorbency.

Papermakers are aware that fines can be washed from fibrous slurries by screening operations conducted at low fiber consistencies. Various types of rotary screening equipment have been provided for production and laboratory classification of fibers. It will be recognized, however, that low fiber consistency washing without efficient water recovery uses tremendous quantities of water while the use of rotary screens introduces increased power costs in the accomplishment of fines removal. Although it has been recognized that advantages in tissue and toweling paper production and in the products produced thereby can accrue from the removal of fines from fibrous slurries, fines removal has not been generally accepted as a process step in the manufacture of such papers because of the water and power requirements entailed.

Summary of the invention

Inasmuch as a practical process for removing fines from wood pulp slurries was desired as a means of increasing paper absorbency and dryability while reducing pitch accumulation and water usage problems in paper production, the present fines removal process comprising specific slanted screen media operating in conjunction with efficient flotation systems was developed. In general, the present fines removal process comprises at least one slanted screen wherein the screen media is disposed at an angle of about 30° to about 45° with the horizontal. The screen media can be mounted on a structure like that illustrated in the drawing of U.S. 1,951,017, issued to Raymond S. Hatch on Mar. 13, 1934, although other structures meeting the conditions of the present application will aso be found suitable for practice of the invention. The screen media of the advantageous slanted screens are thin perforated plates of metal whose perforations have a diameter and comprise a free area according to the present disclosure. The thin perforated plate screen media require support, and the use of expanded metal plates or other similar structures, with hole sizes of one inch or larger, underneath the screen media has been found desirable to maintain the screen media in a substantially flat surface. Rejects, consisting of water and fines passing through the perforations in the slanted screen media, are processed in flotation systems wherein the pH and chloride ion content together with the spent black liquor solids present are regulated to result in flotation of the fines for removal as a wet mat. The water with fines removed can be used as dilution for fibrous slurries entering the fines removal process. It is an important feature of the present fines removal process that fines are removed from the water rejected from fibrous slurries in a form for disposal by convenient means, for example incineration; this feature reduces water usage and pollution.

It is, accordingly, the principal object of this invention to provide an improved process for the removal of fines from wood pulp fiber slurries and to overcome associated problems and disadvantages.

Another object of this invention is to provide a process for the removal of fines from fibrous slurries containing unbleached sulphite wood pulp fibers prior to the application of subsequent bleaching treatments and papermaking operations to such fiber slurries.

It is a further object of this invention to provide a process for the removal of fines from fibrous slurries containing repulped fibers derived from the waste paper referred to as "broke" in papermaking operations.

It is yet another object of this invention to provide a process for the removal of fines from aqueous slurries of wood pulp fibers, which process employs thin perforated metal plates as screening media, is relatively efficient in

the removal of fines and provides an effective means of reducing water pollution through the efficient reuse of water.

It is still another object of this invention to provide a process for the removal of fines from wood pulp fiber slurries, which process employs spent sulphite liquor solids as an effective and readily available flotation agent to result in a system which produces substantially fines-free wood pulp fibers, fines-free water and fines as separate products.

Brief description of the drawings

Other objects and advantages of this invention will become apparent as the description thereof proceeds in accordance with, and as illustrated by, the accompanying drawings wherein preferred embodiments of the herein disclosed process are illustrated by means of schematic flow charts. The schematic flow charts illustrate fines removal processes for the treatment of wood pulp fibrous slurries to result in substantially fines-free wood pulp slurries for subsequent papermaking processing. Separate streams of substantially fines-free water and fines for respective reuse and disposal are also obtained.

FIGURE 1 is a schematic flow chart of a preferred embodiment of the present fines removal process wherein one slanted screen and one flotation system, comprised of an aeration tank and a flotation tank, is used to accomplish fines removal and water reclamation. The screen accepts of the process illustrated in FIGURE 1 are wood pulp fibers from which the fines entering the process in the fibrous slurry have been removed.

FIGURE 2 is a schematic flow chart of another preferred embodiment of the present invention wherein four slanted screens and two flotation systems are used in conjunction to effect fines removal and water recovery according to the process of the present invention. The fourth screen accepts of the process illustrated in FIGURE 2 are wood pulp fibers from which the fines entering the process in the first fibrous slurry have been substantially removed.

Description of the preferred embodiments

Referring now to FIGURE 1 of the drawings, a fibrous slurry containing wood pulp fibers and fines which are to be removed therefrom is introduced onto and downwardly flowed over the top surface of the screen medium mounted in slanted screen **11**. The slanted screen medium consists of a supported perforated metal plate having a thickness of about 0.005 inch to about 0.010 inch, preferably about 0.008 inch. The supported perforated metal plate has an open area of about 20% to about 35%, preferably about 26% to about 29%, formed by equally spaced circular perforations having a diameter of about 0.2 mm. to about 0.8 mm., preferably about 0.3 mm., although the use of 0.6 mm. perforations has been found advantageous in multiple screen systems. The perforations are relieved, i.e., they are conical in shape with their larger diameters facing the bottom screen surface. The minimum diameters of the relieved perforations are specified above. Such perforations are conveniently placed in the metal plate forming the slanted screen medium by photo-etching. The screen medium mounted in slanted screen **11** and in other slanted screens operated in accordance with the present invention has a downward length to width ratio range of about 2:1 to about 6:1, preferably about 4:1, to insure a sufficient length of fibrous slurry travel for the passage of screen rejects through the screen perforations to occur.

Although the introduction of the fibrous slurry onto the top surface of the screening medium installed in the slanted screen **11** is preferably accomplished by a flat distributor nozzle, the fibrous slurry can be flowed onto the screening medium by any convenient means, including, for example, a flat overflow plate extending across the width of the slanted screen or any of the various headbox arrangements known and employed in the papermaking art for feeding fibrous slurries onto Fourdrinier wires.

Fibrous slurries are flowed onto the screen media of the present process at fiber consistencies of about 0.1% to about 1.0%, preferably about 0.7%, for effective fines separation. The screen media are loaded at rates of about 10 gallons per minute to about 20 gallons per minute, preferably about 18 gallons per minute, per square foot of screen media.

The fibrous slurry flows downwardly over the surface of the screening medium, which is disposed at an angle of about 30° to about 45°, preferably about 35°, with the horizontal. During the downward flow, fines and the bulk of the water making up the fibrous slurry pass through the screening medium perforations and are conducted to the aeration tank **12** of the flotation system. The screen accepts, consisting of wood pulp fibers from which fines have been removed, are collected and conducted to further papermaking operations. In the instance where the input fibrous slurry contains unbleached sulphite wood pulp fibers, the screen accepts are conducted to subsequent bleaching operations prior to sheet formation. In the case where the initial fibrous slurry contains bleached wood pulp fibers, for example broke fibers, the screen accepts are rebleached and/or blended, as desired, with other fibrous slurries in the papermaking process.

As stated above, the bulk of the water carrying a substantial portion of the fines in the input fibrous slurry flowed downwardly over slanted screen **11** passes through the screen medium perforations and is collected in the aeration tank **12** of the flotation system. In the aeration tank **12** of the flotation system, the fines carrying water is adjusted to a pH of about 6.9 to about 7.5, preferably about 7.2, by the addition of either spent sulphite liquor from pulp digestion operations, within the amounts prescribed below, to lower the pH or by the addition of lime to raise the pH. Other acidic or basic reagents, for example alum, sulfuric acid and sodium hydroxide can be employed to effect the desired pH control. Alternatively, the pH of the water making up the fibrous slurries entering the fines removal process can be adjusted to the pH required for effective flotation.

In the aeration tank **12**, air is introduced into the fines carrying water which contains about 0.04% to about 0.8%, preferably about 0.06% by weight of spent sulphite liquor solids. The required spent sulphite liquor solids content is conveniently reduced and maintained by controlled washing of unbleached fibrous slurries prior to their entry into the fines removal process. Spent sulphite liquor can be added to fibrous slurries or to screen rejects to increase the spent sulphite solids content. The chloride ion content of the fines carrying water is maintained at less than about 150 p.p.m., preferably less than about 50 p.p.m. to facilitate flotation. The fibrous slurries entering the fines removal process are washed and diluted with water selected for low chloride ion content.

After the introduction of air into aeration tank **12** under a pressure of about 5 p.s.i.g. to about 60 p.s.i.g. as small bubbles and in sufficient volume to provide about 0.05 to about 0.40, preferably about 0.13 standard cubic feet per minute per 100 gallons of fines carrying water or screen rejects, the aerated fines carrying water is passed into flotation tank **13** which is sized to provide a relatively quiescent holding time of about 10 to about 20 minutes, preferably about 12 minutes.

Air introduced into the fines carrying water in aeration tank **12** coalesces with the fines in flotation tank **13**, which fines float to the water surface and form a wet mat having a fiber consistency of about 0.1% to about 7.0%. The wet mat is removed from the water surface in flotation tank **13** by mechanical rakes and is thereafter centrifuged to a solids consistency of about 10% to about 25% prior to disposal of the fines by incineration. Alternatively, the fines can be further dried and combined with waste wood and bark to constitute a valuable fuel supply for the generation of steam. The fines free water issuing from the bottom of flotation tank **13** can be used, as required and illus-

trated by the dashed line in FIGURE 1, to dilute the fibrous slurry. Alternatively, the fines free water can be sewered or used as dilution water in other process streams.

FIGURE 2 of the accompanying drawings illustrates a fines removal process which uses four slanted screens **21, 22, 23** and **24** together with two flotation systems, comprised respectively of first aeration tank **25** and first flotation tank **26** and of second aeration tank **27** and second flotation tank **28**, in yet another preferred embodiment of the present invention. It will be understood that the slanted screens and flotation systems comprising the process illustrated in FIGURE 2 can be operated under the conditions specified above for the slanted screen and flotation system of FIGURE 1. The fines removal process illustrated in FIGURE 2 will, however, benefit from the selection of screen media having increased perforation diameters and free areas for use in third slanted screen **23** and fourth slanted screen **24** as discussed below. In the fines removal process of FIGURE 2, a first fibrous slurry containing fines which are to be removed is introduced onto and downwardly flowed over the top surface of the screen media in the first slanted screen **21**. The bulk of the water associated with said first fibrous slurry passes through the perforations of the screen media mounted in first slanted screen **21** as first screen rejects and is collected for treatment in the first flotation system. Fines free water from the first flotation system is collected from the bottom of the first flotation tank **26**. Fines are collected from the top of first flotation tank **26** for disposal in the manner previously described for operation of the fines removal process illustrated in FIGURE 1.

The wood pulp fibers running down the top surface of the first slanted screen **21** as first screen accepts are rediluted with water passing through the third slanted screen media as third screen rejects and introduced on the top surface of the second slanted screen **22** as the second fibrous slurry. Water passing through the perforations of the second slanted screen **22** as second screen rejects is treated in the second flotation system, comprised of second aeration tank **27** and second flotation tank **28**, to separate fines for disposal and to produce fines free water. The fines free water from the second flotation system is used to dilute the third screen accepts prior to their introduction as the fourth fibrous slurry onto the top surface of the screen media in fourth slanted screen **24**.

The second screen accepts from second slanted screen **22** are diluted with water passing through the perforations of the screen media in fourth slanted screen **24** prior to their introduction onto the top surface of the screen media in third slanted screen **23** as the third fibrous slurry.

In the manner described, the first fibrous slurry entering first slanted screen **21** is classified and separated into the three following ultimate streams. First, water substantially free from fines flows as fines free water from first flotation tank **26** of the first flotation system. Second, fines removed for disposal are separated at first flotation tank **26** and second flotation tank **28**. Third, accepted wood pulp fibers flow downwardly over the top surface of the fourth slanted screen **24** and are collected as fourth screen accepts which are passed to bleaching or to pulp blending operations.

The use of four slanted screens and two flotation systems, operated under the conditions described above in the process illustrated by FIGURE 2, enables a more selective fines removal than does the process using one slanted screen and one flotation system as illustrated by FIGURE 1. The selectivity of the fines removal process illustrated by FIGURE 2 can be further enhanced by selecting screening media having perforations of a greater diameter and increased free area for use in third slanted screen **23** and fourth slanted screen **24**. For example, the perforated plates selected for use as the screening media in the first slanted screen **21** and in the second slanted screen **22** can have perforations with a diameter of about 0.3 mm. and a free area of about 26%, while the screen media selected for use in the third slanted screen **23** and the fourth slanted screen **24** can have perforations with a diameter of about 0.6 mm. and a free area of about 29%.

The selection of perforated plate screening media with perforations of smaller diameter and lesser free area in the first slanted screen **21** and the second slanted screen **22** favors the retention of accepts fibers at the expense of retaining an increased proportion of fines. The selection of screening media with larger diameter perforations and greater free area for use in the third slanted screen **23** and the fourth slanted screen **24** favors the separation of fines. The separation of fines from a fibrous slurry can be considered as a matter of probability so that the foregoing selection of screening media and recycling of screen accepts, screen rejects and fines free water results in an increased probability for the acceptance of fibers free from fines as fourth screen accepts. Fines are concentrated in the water passing through the perforations of the screen media in the first slanted screen **21** and the second slanted screen **22** for subsequent separation and disposal through the flotation systems.

The method of operation and result obtained from operation of the fines removal process illustrated in FIGURE 2 is more fully explained by the following numerical example wherein about 47 pounds per minute of unbleached sulphite pulp at a fiber consistency of about 0.70% is introduced onto the top surface of the screen medium in first slanted screen **21**. The perforated screen medium of the first slanted screen **21** is disposed at an angle of 35° with the horizontal and has dimensions of about 42 inches by about 159 inches with the longer dimension in the slanted direction. The perforated plate screening medium of first slanted screen **21** is about 0.008 inch thick and is provided with 0.012 inch relieved perforations, i.e., perforations which are 0.012 inch in diameter at the top surface of the screening medium and .014 inch in diameter at the bottom surface of the screening medium. The perforartions are arranged in a 60° array on 0.022 inch centers to provide a total open area of 26%. The amount of incoming pulp fibers at the fiber consistency described above results in an overall first fibrous slurry loading of about 18 gallons per minute per square foot on the screen medium of first slanted screen **21**.

Sixty-five percent of the water associated with the first fibrous slurry passes through the slurry perforations in the screen medium as first screen rejects and carries with it about 40% of the fines in the initial unbleached sulphite pulp. The first screen rejects carrying fines from the first slanted screen **21** are collected and passed to the first flotation system for aeration in first aeration tank **25**. The aerated first screen rejects are then passed to first flotation tank **26** for fines flotation and removal to produce water substantially free of fines and water pollutants as measured in terms of suspended solids.

The first screen accepts, consisting of unbleached sulphite pulp fibers together with water which does not pass through the perforations of the screen medium mounted in the first slanted screen **21** are rediluted with third screen rejects to a fiber consistency of approximately 0.70%. This rediluted unbleached sulphite pulp slurry, the second fibrous slurry, is then introduced onto the top surface of the screen medium in second slanted screen **22**. The screen medium mounted in second slanted screen **22** is identical to that mounted in first slanted screen **21**.

Sixty-five percent of the water in the input unbleached sulphite pulp slurry, entering second slanted screen **22** as the second fibrous slurry, passes through the perforations of the screening medium in second slanted screen **22** and carries with it approximately 40% of the fines remaining in the second fibrous slurry. The fines carrying water which has passed as second screen rejects through the screening medium of second slanted screen

22 is passed to second aeration tank 27 in the second flotation system for aeration prior to fines removal in second flotation tank 28. The aerated fines carrying water from second aeration tank 27 passes into second flotation tank 28 wherein the fines form a wet mat on the liquid surface for removal by mechanical rakes. Fines free water issuing from the second flotation tank 28 is used as dilution water for the third screen accepts to form the fourth fibrous slurry entering fourth slanted screen 24.

The unbleached sulphite pulp fibers passing downwardly over the top surface of the screening medium in slanted screen 22 as second screen accepts are rediluted to a 0.70% fiber consistency with fourth screen rejects from fourth slanted screen 24 and passed as the third fibrous slurry to third slanted screen 23. Third slanted screen 23 is equipped with a screening medium in which the relieved perforations have a diameter of 0.024 inch on the top side and a diameter of 0.026 inch on the bottom side. The perforations in the screen medium of third slanted screen 23 are arranged in a 60° array on 0.042 inch centers. This diameter and arrangement of screen perforations provides a total open area of approximately 29% in the screening medium of third slanted screen 23. Third slanted screen 23 is loaded with the third fibrous slurry at an approximate rate of 18 gallons per minute per square foot. Sixty-five percent of the water in the third fibrous slurry passes as third slanted screen 23 together with approximately 45% of the fines remaining in the third fibrous slurry which contains unbleached sulphite pulp fibers which have previously passed as first screen accepts and second screen accepts from first slanted screen 21 and second slanted screen 22. The water passing as third screen rejects through the perforations of the screen media mounted on third slanted screen 23 is recycled for dilution of the first screen accepts to form the second fibrous slurry for screening on second slanted screen 22.

The unbleached sulphite pulp which passes downwardly over the top surface of the screen medium in third slanted screen 23 as third screen accepts is rediluted to a fiber consistency of approximately 0.70%, using fines free water from the second flotation tank 28, prior to its introduction into fourth slanted screen 24 as the fourth fibrous slurry. Fourth slanted screen 24 is equipped with a screening medium having perforations which are identical to those in the screening medium used in third slanted screen 23. Sixty-five percent of the water entering fourth slanted screen 24 with the fourth fibrous slurry passes through the screen medium perforations as fourth screen rejects and carries with it approximately 45% of the fines remaining in the fourth fibrous slurry. The fourth screen rejects are recycled to dilute the second screen accepts to form the third fibrous slurry entering third slanted screen 23. The accepted unbleached sulphite fibers passing downwardly over the top of the screen medium in fourth slanted screen 24, as fourth screen accepts, are collected and passed to subsequent bleaching operations in the papermaking process.

The fines carrying water passing as first screen rejects and second screen rejects through the screening media of first slanted screen 21 and second slanted screen 22 is fed respectively to the first and second flotation systems. Flotation efficiency in both the first and second flotation systems is achieved in part by maintaining the fines carrying water in these flotation systems at a pH of 7.2. The addition of lime to the first fibrous slurry is a convenient method of effecting pH control in the present process as applied to unbleached sulphite pulp fibers, since the fines carrying water is normally at a pH lower than desired. The control of pH in flotation is, however, an essential feature and can be effected at any convenient point in the process. The spent sulphite liquor solids concentration in the flotation systems is preferably maintained at about 0.06% by weight for flotation efficiency, and this spent sulphite liquor solids concentration is achieved by control of the pulp washers used to remove spent sulphite liquor from unbleached sulphite wood pulp entering the fines removal process.

When the present fines removal process is used to remove fines from repulped broke fibers, it is necessary to add spent sulphite liquor solids within the described limits to promote fines separation in the flotation systems. The required spent sulphite liquor solids can be added at any point in the process, but are conveniently added to the first fibrous slurry. Flotation efficiency is also maintained by controlling the chloride ion concentration of the fines carrying water in the flotation systems at less than about 150 p.p.m. and preferably less than about 50 p.p.m. The necessary chloride ion control is achieved by monitoring dilution water entering the fines removal system with the first fibrous slurry and rejecting dilution water streams having a high chloride ion content. Careful control of the residual chlorine content in bleaching systems supplying dilution water to make up the first fibrous slurry is an effective means of insuring the chloride ion control necessary for the present fines removal process. The flotation systems are operated at a temperature of about 75° F.

Both the first flotation system and the second flotation system are comprised in part by aeration tanks, first aeration tank 25 and second aeration tank 27, wherein air at the rate of about 0.05 to about 0.40, preferably about 0.13, standard cubic feet per minute per 100 gallons of fines carrying water is introduced into the system in the form of fine bubbles which selectively cling to the fines particles. In each of the flotation systems the aerated fines carrying water is discharged into flotation tanks, first flotation tank 26 and second flotation tank 28. First flotation tank 26 and second flotation tank 28 are both rectangular tile tanks having a depth of 7.5 feet. These tile tanks are compartmented to form three sections. The sections are an entry section into which the aerated fines carrying water is discharged, a flotation section which provides the holding time necessary for fines to float to the surface and a sludge section into which the fines are scraped off the liquid surface of the flotation section by mechanical rakes. The flotation section of the flotation tanks provides a minimum residence time of 12 minutes. The fines removal process illustrated in FIGURE 1 is equipped with a similar aeration tank and flotation tank.

The fines removal process illustrated in FIGURE 2 is capable of removing about 70% to about 85% of the fines accompanying the unbleached sulphite pulp fbers entering the fines removal system as the first fibrous slurry on the top surface of the first slanted screen 21. The water pollution control effectiveness of the fines removal process illustrated by FIGURE 2 is readily apparent when it is stated that about 90% of the fines removed by the process are collected for disposal by incineration or by other methods which do not introduce the removed fines into discharge water streams.

Applicants prefer to carry out the present fines removal process in the manner illustrated by the schematic flow chart illustrated in FIGURE 2. It will be readily understood, however, by those skilled in the papermaking arts that the invention described herein resides in the screening media and disposition thereof in the slanted screens and in the process conditions maintained in the slanted screens and in the flotation systems. Specific embodiments of the cooperation of these elements in complete processes are illustrated by FIGURES 1 and 2. It is to be understood, therefore, that the particular screens, flotation systems and processes herein illustrated and described are to be taken as preferred embodiments. Various changes in screening media selection and in flotation system process control, within the limits set forth in the attached claims, can be made without departure from the invention. Also, the number of slanted screens and flotation systems cooperating together to form a fines re-

moval system having a desired result can be varied considerably within the scope of the present invention.

The present process has been found to be advantageous in that it effects fines removal without requiring the large amounts of dilution water used with woven wire screen media to effect fines removal in conventional equipment. The removal of fines also permits the use of green wood, or wood which has remained in wood yard storage for a lesser period, without encountering excessive pitch problems. Increased dryability and absorbency in papers produced from the product pulps with fines removed is an additional and important advantage in that higher production rates can be obtained with these pulps without the necessity of adding to or replacing existing paper machines. A further advantage of the present process is that fines are separated and collected in a form suitable for disposal as opposed to fines collection in dilute slurries. Another important feature of the present fines removal process resides in the discovery that the disclosed relieved screen perforations and free areas are essential to efficient fines removal in processes which avoid the screen media plugging associated with the use of woven screen media.

Having thus described and defined the present invention, what is claimed is:

1. A process for the removal of fines from a wood pulp fibrous slurry by screening said slurry, which process comprises the steps of:
   (1) screening said fibrous slurry at a fiber consistency of about 0.1% to about 1.0% and a rate of about 10 gallons per minute to about 20 gallons per minute per square foot of screening medium by passing said fibrous slurry downwardly over the surface of at least one perforated plate screening medium disposed at an angle of about 30° to about 45° with the horizontal and having a downward length to width ratio range of about 2:1 to about 6:1, said screening medium consisting of a supported perforated metal plate having a thickness of about 0.005 inch to about 0.010 inch, having equally spaced circular perforations of about 0.2 mm. to about 0.8 mm. in diameter relieved on the underside of said screening medium and having an open area of about 20% to about 35%,
   (2) passing screen rejects, consisting of water containing fines and issuing from the underside of said screening medium, to an aeration tank in a fines flotation system, wherein the screen rejects have a pH of about 6.9 to about 7.5, contain about 0.04% to about 0.8% by weight of spent sulphite liquor solids and contain less than about 150 p.p.m. of chloride ion,
   (3) aerating the screen rejects in the aeration tank prior to the removal of fines in a flotation tank,
   (4) removing fines from the screen rejects by flotation as a wet mat floating on the surface of a flotation tank having sufficient volume to provide about 10 minutes to about 20 minutes holding time,
   (5) returning the screen rejects with fines removed from step (4) as dilution for the wood pulp fibrous slurry entering step (1),
   (6) disposing of the fines removed by flotation as a wet mat in step (4), and
   (7) collecting accepted wood pulp fibers running down the top surface of said screening medium for subsequent processing steps.

2. The process for the removal of fines of claim 1 wherein the wood pulp fibrous slurry contains unbleached sulphite wood pulp fibers.

3. The process for the removal of fines of claim 1 wherein the wood pulp fibrous slurry contains bleached sulphite wood pulp fibers derived from repulping broke.

4. A process for the removal of fines from a wood pulp fibrous slurry by screening said slurry, which process comprises the steps of:
   (1) screening said fibrous slurry at a fiber consistency of about 0.7% and a rate of about 18 gallons per minute per square foot of screening medium by passing said fibrous slurry downwardly over the surface of at least one perforated plate screening medium disposed at an angle of about 35° with the horizontal and having a downward length to width ratio of about 4:1, said screening medium consisting of a supported perforated metal plate having a thickness of about 0.008 inch, having equally spaced circular perforations of about 0.3 mm. in diameter relieved on the underside of said screening medium and having an open area of about 26%,
   (2) passing screen rejects, consisting of water containing fines and issuing from the underside of said screening medium, to an aeration tank in a fines flotation system, wherein the screen rejects have a pH of about 7.2, contain about 0.06% by weight of spent sulphite liquor solids and contain less than about 50 p.p.m. of chloride ion,
   (3) aerating the screen rejects in the aeration tank prior to the removal of fines in a flotation tank,
   (4) removing fines from the screen rejects by flotation as a wet mat floating on the surface of a flotation tank having sufficient volume to provide about 12 minutes holding time,
   (5) returning the screen rejects with fines removed from step (4) as dilution for the wood pulp fibrous slurry entering step (1),
   (6) disposing of the fines removed by flotation as a wet mat in step (4), and
   (7) collecting accepted wood pulp fibers running down the top surface of said screening medium for subsequent processing steps.

5. A process for the removal of fines from an unbleached sulphite wood pulp fibrous slurry which process comprises the steps of:
   (1) screening said fibrous slurry at a fiber consistency of about 0.1% to about 1.0% and a rate of about 10 gallons per minute to about 20 gallons per minute per square foot of screening medium by passing said fibrous slurry downwardly over the surface of four consecutive perforated plate screening media disposed at an angle of about 30° to about 45° with the horizontal and having a downward length to width ratio range of about 2:1 to about 6:1, said screening media consisting of supported perforated metal plates having a thickness of about 0.005 inch to about 0.010 inch, having equally spaced circular perforations of about 0.2 mm. to about 0.8 mm. in diameter relieved on the underside of said screening media and having an open area of about 20% to about 35%,
   (2) passing separately the first and second rejects, consisting of water containing fines and issuing from the underside of the first and second of said screening media, to a first aeration tank and a second aeration tank in a first and a second flotation system, respectively, wherein the screen rejects have a pH of about 6.9 to about 7.5, contain about 0.04% to about 0.8% by weight of spent sulphite liquor solids and contain less than about 150 p.p.m. of chloride ion,
   (3) aerating the first and second screen rejects in the first and second aeration tanks prior to the removal of fines in a first and second flotation tank,
   (4) removing fines from the first and second screen rejects by flotation as a wet mat floating on the surface of a first and a second flotation tank each having sufficient volume to provide about 10 minutes to about 20 minutes holding time,
   (5) passing the first screen rejects with fines removed in step (4) from said process,
   (6) returning the second screen rejects with fines removed from step (4) as dilution for the third screen accepts passing downwardly over the surface of the

screen medium in the fourth slanted screen as the fourth fibrous slurry,

(7) disposing of the fines removed by flotation as wet mats in the first and second flotation tanks of step (4), and

(8) collecting the accepted unbleached sulphite wood pulp fibers running down the top surface of the screen medium in the fourth slanted screen as fourth screen accepts for subsequent bleaching steps.

6. A process for the removal of fines from an unbleached sulphite wood pulp fibrous slurry, which process comprises the steps of:

(1) screening said fibrous slurry at a fiber consistency of about 0.7% and a rate of about 18 gallons per minute per square foot of screening medium by passing said fibrous slurry downwardly over the surface of four consecutive perforated plate screening media disposed at an angle of about 35° with the horizontal and having a downward length to width ratio of about 4:1, said screening media consisting of supported perforated metal plates having a thickness of about 0.008 inch, having equally spaced circular perforations of about 0.3 mm. in diameter in the first and second consecutive perforated plate screening media and about 0.6 mm. in the third and fourth consecutive perforated plate screening media, which circular perforations are relieved on the underside of said screening media, and said screening media having an open area of about 26% in the first and second consecutive perforated plate screening media and about 29% in the third and fourth consecutive perforated plate screening media,

(2) passing separately the first and second rejects, consisting of water containing fines and issuing from the underside of the first and second of said screening media, to a first aeration tank and a second aeration tank in a first and a second flotation system, respectively, wherein the screen rejects have a pH of about 7.2, contain about 0.06% by weight of spent sulphite liquor solids and contain less than about 50 p.p.m. of chloride ion,

(3) aerating the first and second screen rejects in the first and second aeration tanks prior to the removal of fines in a first and second flotation tank,

(4) removing fines from the first and second screen rejects by flotation as a wet mat floating on the surface of a first and a second flotation tank each having a sufficient volume to provide about 12 minutes holding time,

(5) passing the first screen rejects with fines removed in step (4) from said process,

(6) returning the second screen rejects with fines removed from step as dilution for the third screen accepts passing downwardly over the surface of the screen medium in the fourth slanted screen as the fourth fibrous, slurry,

(7) disposing of the fines removed by flotation as wet mats in the first and second flotation tanks of step (4), and

(8) collecting the accepted unbleached sulphite wood pulp fibers running down the top surface of the screen medium in the fourth slanted screen as fourth screen accepts for subsequent bleaching steps.

References Cited

UNITED STATES PATENTS

1,718,385	6/1929	Sherwood	209—397
1,951,017	3/1934	Hatch	209—17 X
2,330,589	9/1943	Juell	210—44
2,331,455	10/1943	Cowles	209—17 X
2,335,209	11/1943	Booth	210—44

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209—10, 273, 397; 162—55; 210—44.