In a vortex-type slurry separator dilution liquid is introduced through an eddy chamber adjacent the separator body, the chamber having a transfer opening which extends through the wall of the body to allow overlap of a dilution liquid body with the outer vortex in the separator, so that the liquid will pass smoothly into the outer vortex by eddy current transfer.

5 Claims, 3 Drawing Figures
VOX-TYPE SLURRY SEPARATOR
BACKGROUND OF THE INVENTION

1. Field of the invention
This invention relates to dilution in vortex-type slurry separators (hydrocyclones), such as are used, e.g., to remove specks, dirt, metal, and other impurities from paper and pulp slurries.

2. Description of the prior art
Dilution is commonly carried out in a vortex separator both to aid separation by reducing consistency in the outer vortex, and, by reducing the bleed rate (i.e., the fraction of solids in the original slurry appearing in the rejects flow), to decrease the amount of acceptable stock lost. In some devices, diluent has been introduced through a nozzle-like opening in a converging outlet section of the separator body. In others, the diluent has been introduced downstream of such converging section, through an additional diverging frustoconical wall of an elutriation chamber, e.g., as shown in U.S. Pat. No. 3,612,276.

SUMMARY OF THE INVENTION

The invention makes possible excellent mixing of dilution liquid into the outer vortex, with simple controls (e.g., without an undesirable highly sensitive relationship between bleed rate and the dilution liquid flow rate, which complicates bleed rate control), and with reliable, inexpensive apparatus. Easy access to the rejects orifice is provided. Separation efficiency is high. The dilution can be carried out sufficiently upstream of the rejects orifice to permit recombination of the rejects. The liquid can be effectively added over a wide range of dilution flow rates, in both large and small diameter separators.

In general, the invention features introduction of dilution liquid through an eddy chamber adjacent the separator body, the chamber having a transfer opening which extends through the wall of the body to allow overlap of a dilution liquid eddy with the outer vortex in the separator, so that the liquid will pass smoothly into the outer vortex by eddy current transfer. In preferred embodiments the eddy chamber has an inside diameter between one-sixth and 6 times the inside diameter of the separator body at the transfer opening; at least 10 percent of the axial extent of the separator body lies downstream of the transfer opening with respect to the outer vortex; and at least 40 percent thereof lies upstream of the transfer opening; and, in embodiments having a converging body section, the transfer opening communicates with the converging section intermediate the maximum and minimum diameters thereof.

Other advantages and features of the invention will be apparent from the description and drawings herein of a preferred embodiment thereof.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is an elevational view, partly sectioned, of a typical example of a vortex separator embodying the invention. FIG. 2 is an enlarged fragment of FIG. 1, without the sectioning.

FIG. 3 is a sectional view taken along line 3-3 of FIG. 2.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawing, the separator has a tubular body 10 with a cylindrical section 12 and a downwardly converging generally frusto-conical section 14 terminating in rejects orifice 16. At the upper end of portion 12 are tangential slurry inlet 18 and outlet 20 with vortex finder 22 aligned with the separator axis.

Toward the lower end of portion 14 the separator is laterally enlarged to provide a housing 30 having an internal cylindrical wall 32 which curves smoothly about axis 34 generally parallel to the main separator axis 36 to form an eddy chamber 38. The chamber has a tangential inlet 40 and a transfer opening 42 which opens into the adjacent portion of the separator proper which is formed by a second cylindrical wall 44 in housing 30. Thus, the separator wall 44 and wall 32, in cross-section transverse to axes 34 and 36, follow overlapping circles. Edges 46 and 48 are rounded slightly.

In operation, the slurry to be separated is supplied under pressure to inlet 18. Operation of separators of this type is described in the above identified patent. In general, however, the stock, as it flows about and along axis 36, separates into an outer, downwardly progressing vortex containing a large percentage of the heavier material which is to be rejected through orifice 16, and an inner, upwardly progressing vortex containing primarily the acceptable material to be collected through outlet 20.

According to the invention, dilution water is supplied under pressure to inlet 40 and circulates in chamber 38 in a continuing eddy which, through transfer opening 42, overlaps the outer vortex in the separator proper, as suggested by the arrows in FIG. 3. In the zone of overlap dilution water enters the outer separator vortex, mixing smoothly and uniformly in the slurry layer, with minimal loss of the water into the inner vortex. Some solids from the outer vortex pass into chamber 38 to flow in the eddy therein. The dilution of the outer vortex reduces the loss of acceptable solids through orifice 16, increasing separator efficiency. Bleed rate reduction will increase with dilution rate, but the relationship is smooth and relatively insensitive, allowing accurate control over bleed rate without great precision in dilution rate.

In general, the inside diameter of chamber 38 is preferably between one-sixth and 6 times that of the body 10 at opening 42 (average diameters being used if either the chamber or the separator taper at opening 42). Too small an eddy chamber would unduly limit dilution. Preferably, the eddy chamber should be located along the separator axis so that at least 10 percent of the axial extent of body 10 lies downstream of the transfer opening with respect to the outer vortex, and at least 40 percent lies upstream of the transfer opening; in this respect location of the transfer opening too close to orifice 16 causes an overly sensitive dilution rate-bleed rate relationship, and location too far from the orifice results in an excessively high dilution water requirement for a given reduction in bleed rate. Opening 42 should be at least as large as inlet 18, to avoid plugging, and should otherwise be dimensioned so as to preserve true eddy flow in chamber 38 without unduly limiting transfer through the opening. The extent of dilution inlet 40 along axis 34 should be close enough to the axial extent of chamber 38 itself to allow the eddy...
flow to cover the entire internal vertical wall of the chamber.

Other embodiments are within the following claims.

What is claimed is:

1. In a vortex-type slurry separator having a tubular body for containing slurry flowing in a pattern including an outer vortex flowing generally toward one outlet and an inner vortex flowing generally toward another outlet, that improvement consisting of apparatus for introducing dilution liquid into said outer vortex, said apparatus comprising

   a housing positioned adjacent said body and having an internal wall extending smoothly about an axis to form an eddy chamber, said wall having an inlet for introduction of dilution liquid to cause said liquid to form an eddy in said chamber, and a transfer opening which extends through the wall of said body to allow said eddy to overlap said outer vortex, whereby said liquid will pass smoothly into said outer vortex by eddy current transfer.

2. The improvement of claim 1 wherein said chamber has an inside diameter between one-sixth and 6 times the inside diameter of said body at said opening.

3. The improvement of claim 1 wherein at least 10 percent of the axial extent of said tubular body lies downstream of said transfer opening with respect to said outer vortex.

4. The improvement of claim 3 wherein at least 40 percent of the axial extent of said tubular body lies upstream of said transfer opening with respect to said outer vortex.

5. The improvement of claim 3 wherein said tubular body has a converging section, and said transfer opening communicates with said converging section intermediate the maximum and minimum diameters of said converging section.

* * * * *