

The information and data contained in this document were prepared by a technical committee of the Association. The committee and the Association assume no liability or responsibility in connection with the use of such information or data, including but not limited to any liability under patent, copyright, or trade secret laws. The user is responsible for determining that this document is the most recent edition published.

Bleach plant washer efficiency guide

1. Scope

This is a guide for optimizing performance of vacuum washers operating in bleach plant applications. The intent is to provide basic understanding of key operating principles. Additionally, the troubleshooting section will be a guide to assist in normal problem solving.

2. Safety precautions

When dealing with bleach washer measurements, all normal safety precautions predominant in the bleach plant should be strictly adhered to.

3. Introduction

Much has been written about the performance and measurement of vacuum washers in brownstock and post oxygen washing applications. Prior to this writing, little has been written about similar applications for washers in bleach plants. However, due to the higher cost chemicals being required in modern bleach sequences, along with the trend towards fewer bleach stages, the interest in optimizing bleach plant washing efficiency has intensified.

For brownstock and post-oxygen washing applications, it is relatively easy to quantify and benchmark the washing efficiency by utilizing equivalent displacement ratio (EDR) or other measurements. These measurements normally are based on a dissolved solids reduction across the washing stage. These measurements are not as readily available or pertinent in a bleach plant due to:

1. Very low solids levels combined with normal testing accuracy result in low confidence levels.
2. Washing medium can have higher solids levels than the washer feed.
3. Use of multiple shower sources can complicate efficiency determination.

Common methods to overcome these obstacles are to either measure displacement ratio based on sodium ion, chloride ion or conductivity measurements. Alternately, short term operation with fresh or hot water on the showers and measurement of sodium ion, chloride ion, dissolved solids or conductivity can be attempted.

Even though quantification is difficult, it is required that bleach plant washer operation needs to be optimized. Since the traditional efficiency measurements in brownstock and post oxygen service are difficult to apply to bleach washers, it is better to identify the primary goals of the bleach washing stages.

Chlorination (DC) or D100 stage washer

The purpose of this washing stage is to remove the hydrochloric acid (HCL) and organic acids generated in the first bleach stage. Additionally, this washer is utilized to raise the pH and temperature of the pulp for the subsequent alkaline stage. High discharge consistency is preferable to provide the maximum retention time in the subsequent bleach tower, enhance plug flow in the tower and minimize steam requirements.

Normally, the method used to achieve the removal of the reaction by products is to use D stage filtrate or warm fresh water on the first or lower shower bars. The pH and temperature adjustments are facilitated by the use of

extraction stage filtrate on the second or upper shower bars. If the intent is to utilize peroxide in the subsequent extraction stage, careful assessment of the additional organic load from the re-use of extraction stage filtrate should be considered.

The penalty for poor operation on this washing stage include increased chemical usage in the EO stage, increased steam use or inability to reach desired temperatures and reduced tower retention times. These reduced retention times could be due to the lower consistency into the tower, or in the worse case, caused by channeling due to low consistencies.

NOTE 1: If E filtrate is used as the wash medium, be careful not to have a “thin sheet.” If you pull E filtrate through the sheet, you will start foaming in the filtrate tank.

Extraction (E,EO,EOP) stage washer

The purpose of this washing stage is to remove the organic solids and caustic from the extraction stage. Additionally, this washer is utilized to lower the pH and possibly raise the temperature of the pulp for the subsequent stage. High discharge consistency is preferable to provide the maximum retention time in the subsequent bleach tower, enhance the plug flow in the tower and minimize steam requirements.

Normally, the method used to achieve the removal of the reaction by products is to use hot water on the first or lower shower bars. The pH and temperature adjustments are facilitated by the use of clean water or D stage filtrate on the second or upper shower bars.

The penalty for poor operation on this washing stage include increased chemical usage in the D stage, increased steam use or inability to reach desired temperatures and reduced tower retention times, lower final brightness levels, or a decrease in brightness stability. These reduced retention times could be due to the lower consistency into the tower, or in the worse case, caused by channeling due to low consistencies.

Subsequent bleach washers

The additional later stages of washing in the bleach plant have the same purposes as listed above for the respective alkaline and acid stages. The methods and penalties would vary based on the overall bleaching sequence and pulp quality desired.

It is apparent that washer performance in the bleach plant is very important from the operating cost and final pulp quality perspectives. A basic understanding of the operating principles is required to effectively evaluate and improve the various washer operations. The following information is to be used as a resource when working with bleach plant vacuum washers.

Problems with bleach plant washers are usually operational in nature, rather than being caused by inadequate design or mechanical failure, although both can impact operations. This outline first discusses design criteria in a general sense. Then with that as a foundation, discusses in more detail the operating and mechanical issues.

When problems arise, the first step toward solving the problem is to compare the operation to the time before the problem surfaced, and determine what has changed. This often requires knowing something about how the system normally operates, i.e. inlet and discharge consistencies, vat level, clearance from the wire to the take-off device, etc. Sometimes a small amount of accurate historical information is critical for solving a chronic problem.

4. Basic design – the filtration cycle

All vacuum washers operate based on a filtration cycle.

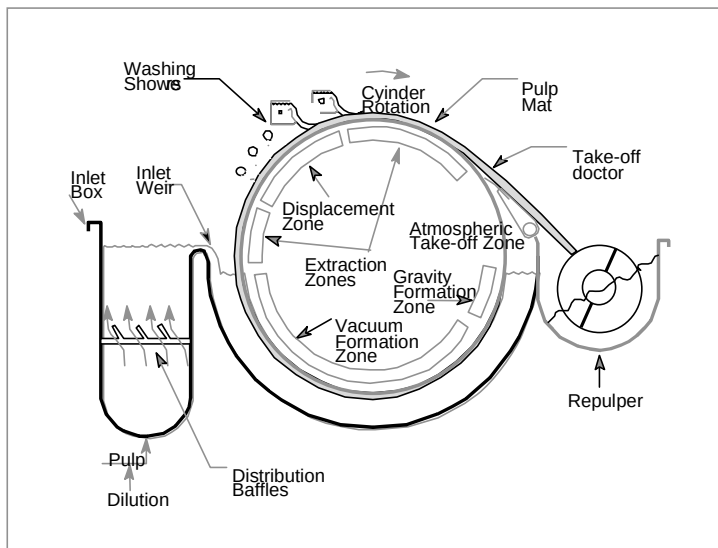
Stock enters the washer as a slurry into the inlet box, or headbox and proceeds over an inlet lip, or weir, to the main washer vat. The vacuum on the washer cylinder causes the slurry to thicken as filtrate is pulled through the face wire and a sheet is formed. The sheet rotates upward through the displacement washing showers, past a vacuum cut off, over a take-off device and discharges into a breaker conveyor or repulper. The two most prevalent bleach plant take-off devices are hydraulic underjet and airlift. Take-off rolls and steam are used limitedly.

Pulp should enter the washing stage at the lowest possible consistency that can be maintained without jeopardizing the operation. Normal design range for feed consistency is 1.0 to 1.5% with 1.25% being typical. Operating at design loading or below, washers will perform well at a consistency around 1.0%. As the production rate increases, the vat consistency may have to be increased as well. This is a function of the overall hydraulic design of the system.

Vacuum Filter Operation

Principles of Washing

- Key issues
 - Distribution baffles
 - Inlet weir
 - Proper shower location
 - Proper shower selection
 - Drum concentricity



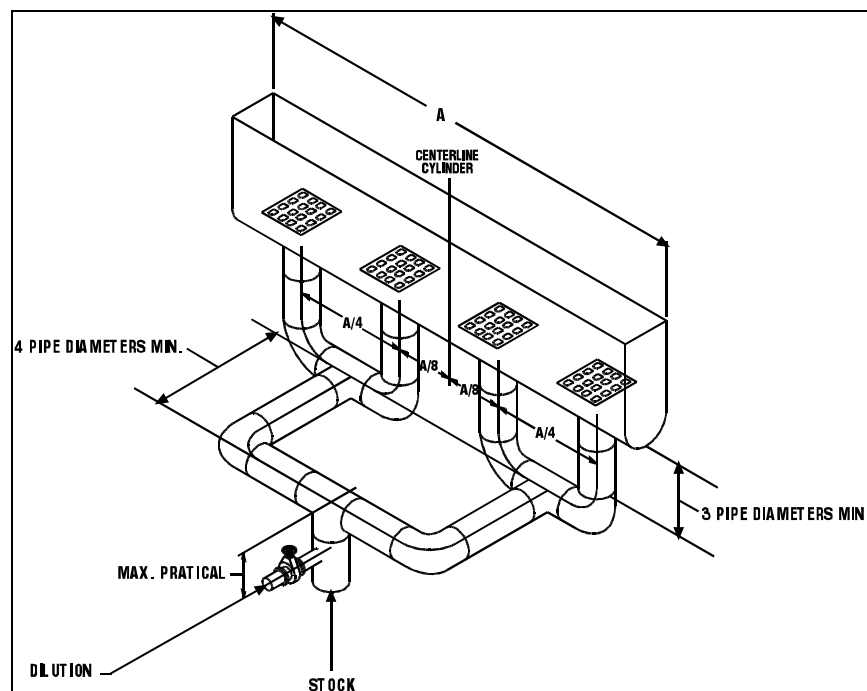
Washing on a rotary vacuum cylinder occurs in two stages in the vat by dilution-extraction as the sheet is formed, and displacement by showers on the cylinder. Washer efficiency will suffer unless both types of washing are handled properly. Dilution-extraction washing occurs when a slurry is diluted with a liquid of lower solids, allowed to mix and then the liquor is extracted. The more vat dilution utilized, the lower the average solids level after extraction. Displacement washing is accomplished by displacing the liquid in the sheet with the liquid in the showers. Displacement washing efficiency is impacted by sheet uniformity and shower distribution.

Normally, bleach vacuum washers discharge in the 10-12% OD range. Improvements in washing efficiency can be realized by increasing the discharge consistency above these levels. This normally is accomplished by optimizing the system hydraulics (i.e., inlet consistency, dropleg flows, etc.) or by utilization of anti-rewet drum designs. These higher consistencies also favorably impact bleach system steam requirements and risks of bleach tower channeling.

There are various ways to control bleach plant washers. Usually, the vat dilution is set manually and the vat level is controlled by cylinder speed. An alternative is to set the drum speed manually and control the vat automatically with dilution. Both systems can have their problems. If, for instance, the washer seals over on dilution control, the dilution will cut off as the vat level rises. This will cause the vat to plug. It is better to let the washer overflow until the seal can be broken. If the washer is on speed control, the sealing condition will be aggravated as the drum speeds up on high level. The concept of the vat level controlling the drum speed is more common. If tuning is a problem, operate the dilution and cylinder speed in manual until the system is stable and then try again in automatic.

4.1 Inlet piping and headbox design. To achieve good washing efficiency, the inlet flow should be of a uniform consistency and evenly distributed across the length of the washer. Inlet piping should be sized for around 1-2 mps (3-6 fps) velocity. For single feed inlets, this velocity can be as high as 3 mps (9 fps). The inlet piping to a washer distributes the pulp slurry into an inlet box or headbox. The flow should be directed via baffles or some similar arrangement in the inlet box. If these baffles have been removed or have broken out, they should be replaced. A washer without distribution baffles will usually run poorly with a large difference in discharge consistency across the face. There will be a thick sheet in line with the stock inlets, tapering down to a thin sheet in areas between the stock inlets. This will result in poor displacement washing efficiency in the areas of the heaviest sheet formation and potentially entrainment of air in the thinnest.

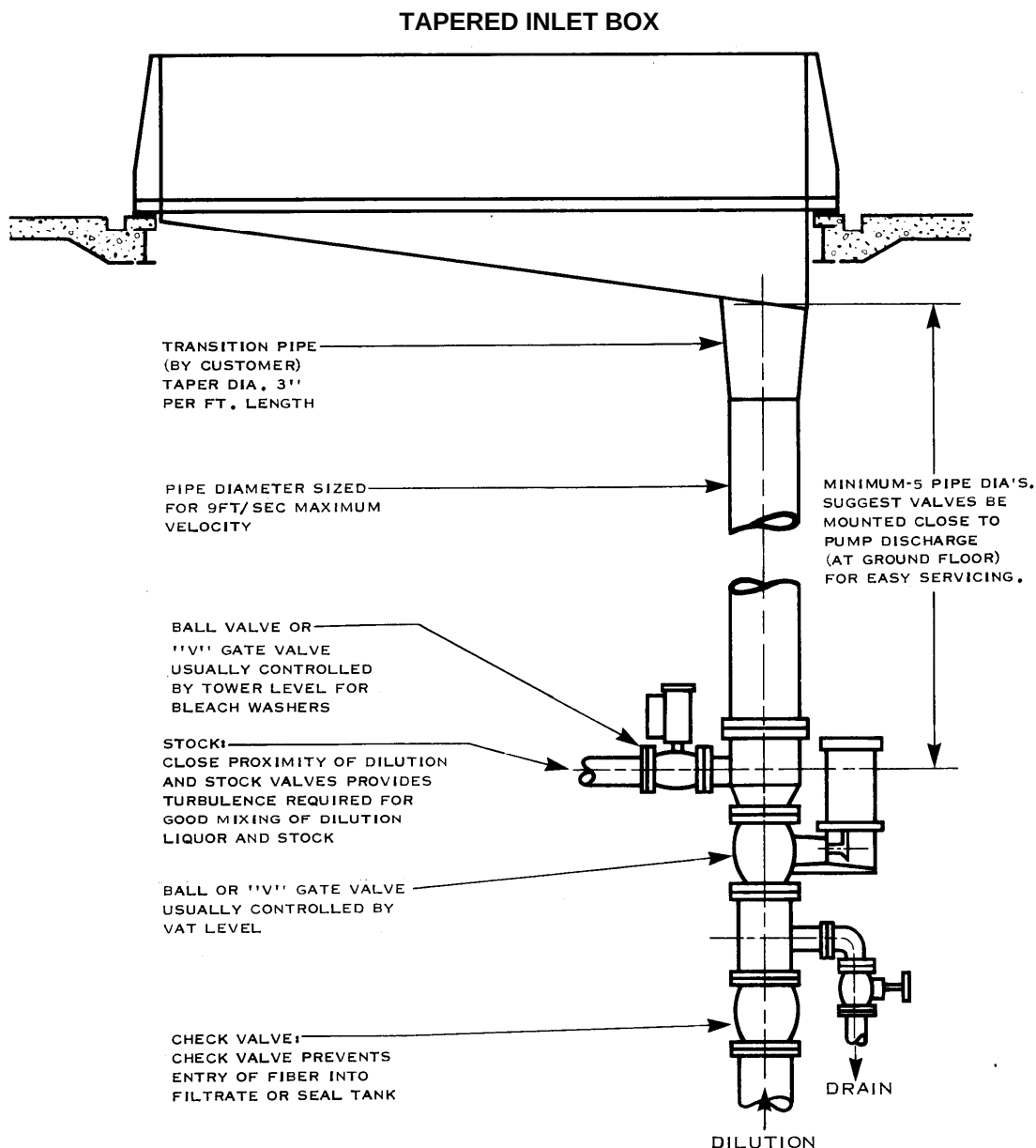
INLET PIPING



One design inlet baffle arrangement covers the entire inlet area with a metal plate with holes to create a small pressure drop. Systems with tapered inlet boxes will have baffle plates across the entire inlet area. The holes in the baffles are made by cutting two sides and bending the resulting tab (or eyebrow) upward leaving a triangle shaped opening. The triangles are three to four inches on a side. The purpose of these tabs is to reduce the velocity and distribute the slurry evenly across the inlet box. The tabs can be bent downward or upward to change the flow pattern when necessary. Also, the plates can be rotated, if needed, to alter the pattern. This should be considered if there are large consistency variations across the length of the headbox.

To determine the uniformity of distribution, inlet box samples can be taken every 30 to 50 cm (12-18 in) and consistencies tested. If uniform distribution cannot be achieved by baffle adjustments, it may be due to inadequate bleach tower blending. The circulators and dilution nozzles in the tower feeding the washer will need to be checked for proper operation.

Proper introduction of vat dilution to the feed line can be achieved by having the dilution line "tee-ing" into the stock line, with the control valve located close to the tee to take advantage of the pressure drop across the valve for mixing. If this is not practical, an orifice can be used to provide similar mixing, but normally at increased pressure drops.



4.2 *Inlet weir and vat.* The design of the inlet weir is very important. The lip or weir should have a small horizontal land area (10 to 30 cm or 4 to 12 in) and then slope gently into the vat. Across this weir, the pulp is thinned to a uniform, shallow depth as it flows over the weir. This allows air bubbles (foam) trapped in the slurry to rise to the surface and break.