ELP Bigshot

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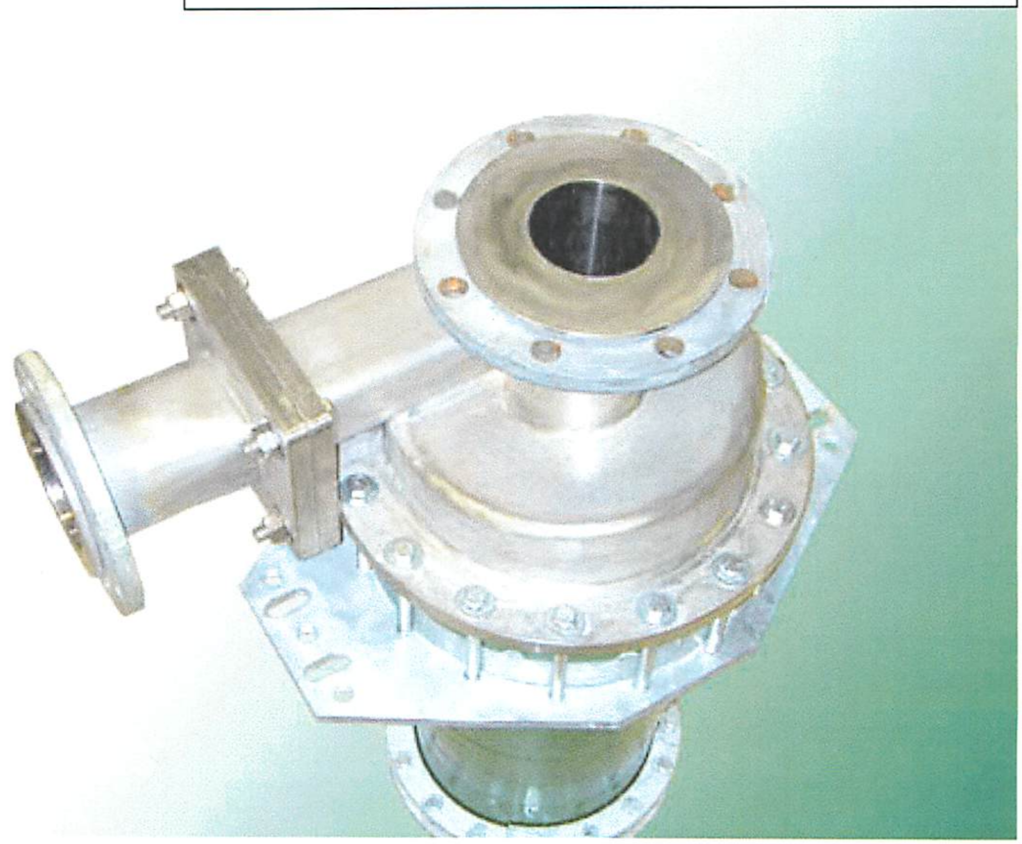


BIGSHOT INTRODUCTION

The Bigshot was designed to replace the most common of the Bauer 620 series cleaners with a higher capacity, lower pressure drop cleaner. The implications of the exchange need to be completely understood. The Bigshot is not a replacement with a like model rather it is an upgrade to the system. It changes the process and should be considered a capital project – the process will be changed as well as a significant cost incurred.

A mill could have a number of reasons for considering the use of a higher capacity, low pressure drop cleaner:

> The mill may want an increase in the capacity of the system without having to go to a new system or having to increase their pump, motor or electrical service. By changing out the cleaners to the Bigshot, those additional requirements may not exist – or may be as little as installing a new impeller in the same pump.
>
> The mill may want to reduce the operating cost of the system by reducing the energy consumption. The ELP Bigshot with its low pressure drop requirement can fill this need.
>
> The mill may want to decrease the pressure on the cleaners. The feed pressure limit on a plastic cleaner maxes out about 65 psi. Many mills will exceed this with larger pumps and failures can occur. This is worse with hot stock – the material properties of the plastics are seriously affected by temperature.

Energy Payback

The Bigshot has a fabricated Stainless Steel head and the cleaner price will vary according to the cost of producing the head. The expense is recoverable in the energy savings. The spreadsheet titled, "Bigshot" will enable you to calculate a "typical" payback period for a specific application based on energy costs alone. This period will generally be between 1 ½ and 4 years – that pays for the cleaners, installation and any adjustment to the pump.

Operating Cost Reduction

Because the Bigshot requires less of a pressure drop for a given flow rate the back pressure against the pump is lower. This benefit may be used in one of two ways. The mill can trim the impeller to maintain capacity and use the reduced energy consumption as cost saving. The mill may keep the increase in capacity – the amount can be determined by examination of the pump curve. The mill could also consider any of the options in between.

Pressure Reduction

Some mills operate their cleaners with pressures that exceed the safe limit for the cleaner. With the use of plastic heads and cone sections this can become a problem especially where high temperatures are found. There are two main sources for this problem.

The mill may be running at a much higher capacity than the original system design. To get the increased flow they must exceed the pressure drop range for that cleaner. The Bigshot capacity range is up to 860 gpm at a pressure drop of 35 psi.

The second scenario often occurs where the mill has a high accept pressure requirement. This may come from the need to drive the headbox or screen after the cleaners. The accept pressure plus the pressure drop may exceed the maximum operating pressure for the cleaner. The Bigshot can reduce this by reducing the pressure drop requirement.

How it Works

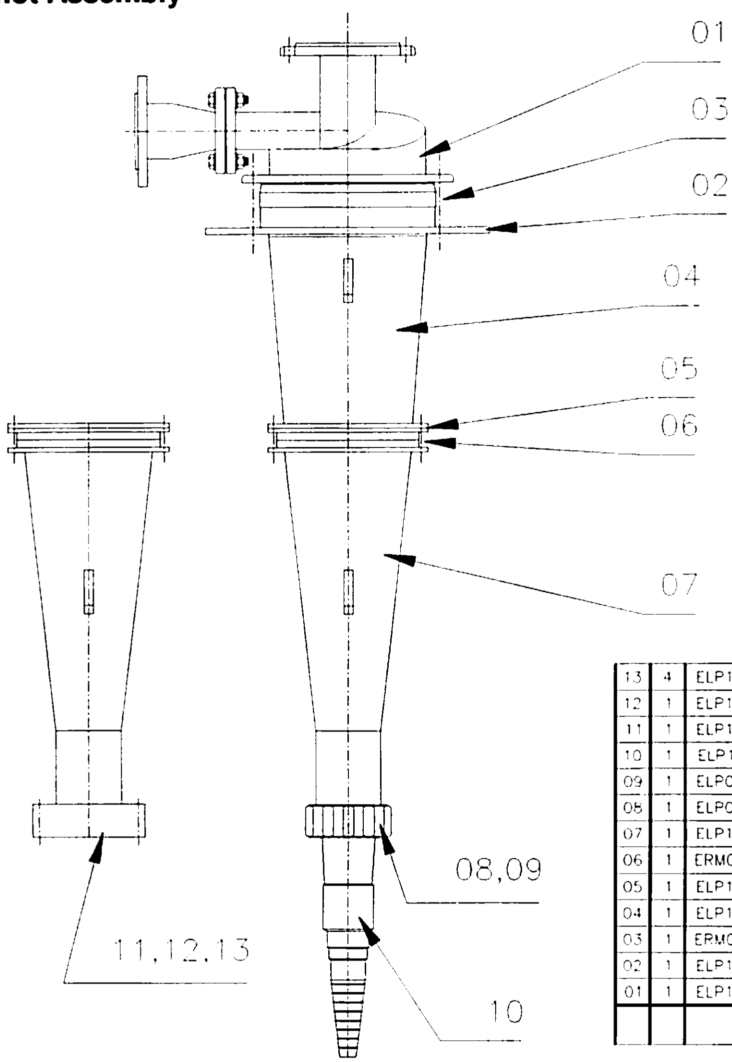
Cleaners are fed through an inlet that consists of a pipe connected tangentially to the body of the cleaner. Stock entering the cleaner forms a vortex that forces heavyweight particles to the wall of the cleaner. As stock continues to enter the cleaner the stream at the wall continues down to exit at the small end of the cone. At the same time the stock near the center of the cleaner becomes constricted by the cone shape and reverses direction to be captured by the accept pipe. Because the heavyweights are all at the wall of the cleaner, this central stream is "cleaned."

The stock entering the cleaner follows the wall of the cleaner and encounters the stock entering the cleaner a moment later. This creates an area of turbulence at the entry which consumes energy. With a flat roof cleaner this can be over half of the energy used by the cleaner. A helical head improves on this, as does a shaped feed pipe. The ELP Bigshot has both – eliminating all entry losses.

CLEANER DESCRIPTION

The ELP Bigshot is a 12" inside diameter cleaner which is meant to replace the most common of the Bauer 620 series cleaners. It consists of a stainless steel head inlet, urethane upper and middle cones, flanges and either a urethane lower cone or a flange which enables the mill to reuse their Bauer ceramic lower cones.

Bigshot Assembly

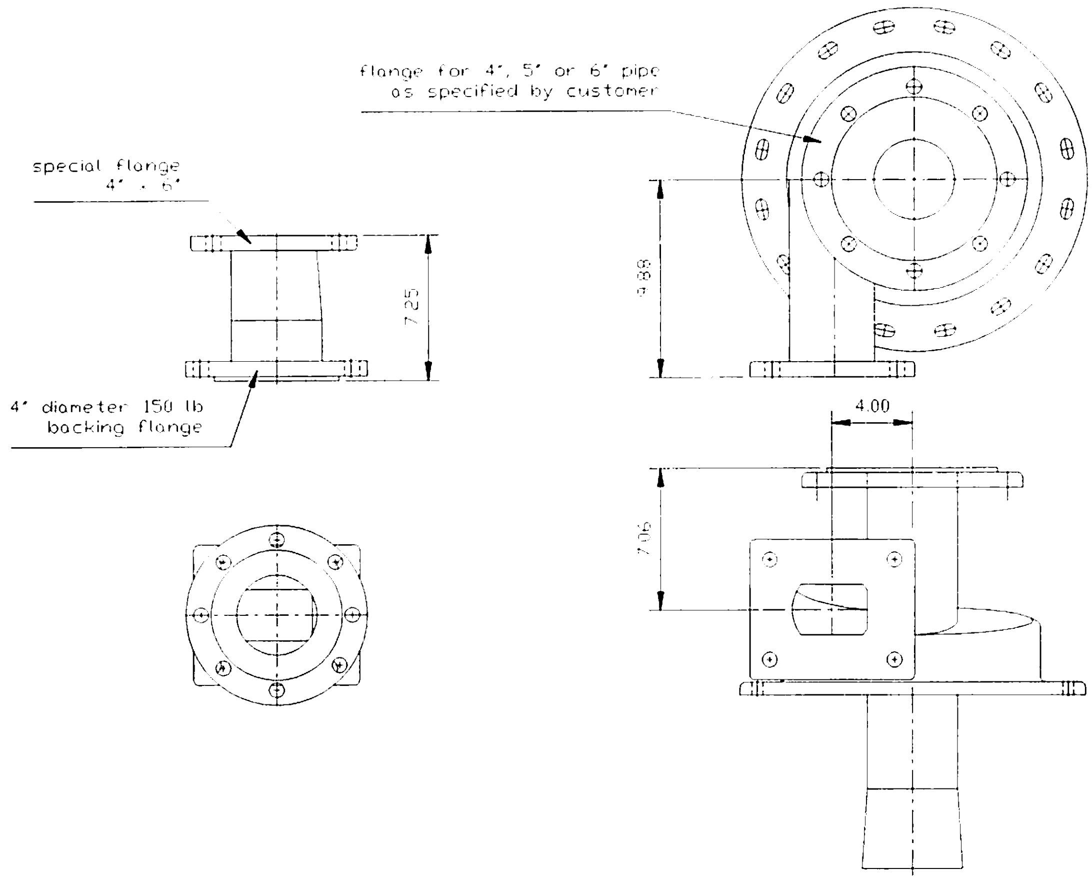


13	4	ELP12383	#12 x 2" Screw
12	1	ELP12384	4 1/2" "O" Ring (2-425)
11	1	ELP12383	Flange for Ceramic Lower Cone
10	1	ELP12301	Lower Cone
09	1	ELP06005	Lower Cone Nut
08	1	ELP06010	4.5" O Ring (2-245)
07	1	ELP12304	Middle Cone
06	1	ERM03252	Middle Bolt Set
05	1	ELP12346	Middle Flange Set
04	1	ELP12313	Upper Cone
03	1	ERM03253	Bigshot Head Bolt Set
02	1	ELP12347	Bigshot Upper Flange Set
01	1	ELP12012	ELP Bigshot Head

For systems where the OEM ceramic is to be used, the parts numbered 08, 09 & 10 are replaced with 11, 12 & 13. The OEM ceramic is attached with the mating flange from the original Bauer cleaner.

Bigshot Head Inlet

The Bigshot head inlet has two principal parts: the head inlet and an inlet transition piece. Two parts are a necessity in order to install the cleaner into the bank where the spacing between cleaners and between the cleaner supports is limited.



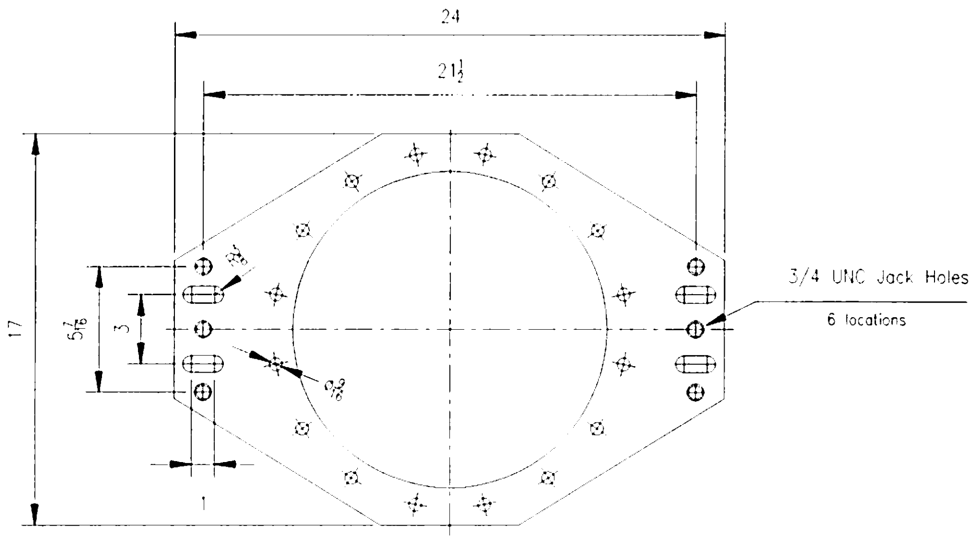
Note the message regarding the top flange on the cleaner. Because of the variations in the Bauer headers, this accommodation is necessary. Because the Bigshot head is a fabricated piece this flange must be specified on the order for the cleaner.

At present there is no accommodation for the 6" victaulic accept. This was an adaptation from Bauer when the original plastic heads came into use. If requested ELP will determine what would be required to make this change.

Similarly the Bauer 624 cleaner has an extended inlet transition piece leading to a 6" diameter pipe flange at the header.

Bigshot Support Flange

The support flange takes the weight of the cleaner to the support structure. It also serves to attach the head inlet to the upper cone.



The support flange is bolted through the four ¾" x 1" slots. For systems where the vertical distances between the support structure and headers is not perfect, there are six tapped holed through which a bolt may be inserted and used to jack the cleaner into position. The bolts for this purpose are a mill supplied item.

BIGSHOT INSTALLATION

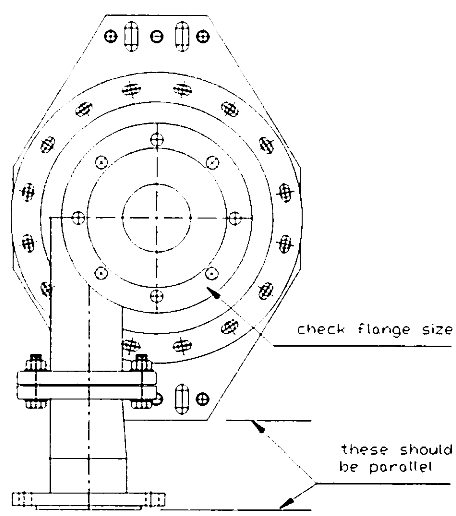
The ELP Bigshot is heavy and personnel who are engaged in the installation should take this into account when moving and lifting the cleaner.

Inspection

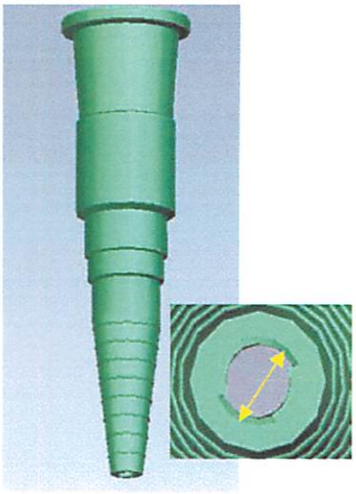
The ELP Bigshot comes assembled on skids. On arrival the cleaners should be checked for obvious damage and loose connections.

Check the flange sizes to ensure that the correct number and size of the flanges meets the requirement. Older systems may have several of each of different sizes.

For headers and support structures the face of the feed flange and the end of the support plate should lie in parallel planes.



Reject Tip Size



Reject tips as delivered by ELP are cut at 1" diameter. These must be corrected to the proper size before the cleaner is put into service. The typical requirement is to make them the same size as the cones which they are replacing. To facilitate cutting the cone at the correct location it is marked along its length with the locations of the various tip sizes.

In service the cone will generally be orientated with the small end pointed down. Cut the tip off at the ring below the size marked on the outside of the cone. If measured the diameter of the reject tip should be measured across the largest diameter of the reject opening. The rifling in the reject makes the outlet appear off round.

Urethane may be cut with any saw. The end cuts should be trimmed to remove any sharp edges that may catch fiber and form strings. This is especially important in applications where the tip is submerged.

Installation

1. Start with the removal of the inlet transition piece and the lower cone. The middle cone may also be removed to reduce weight. This configuration is shown at right.

2. Using a suitable lifting device lift the cleaner into the opening between cleaners. The cleaner will have to be tilted to clear the support beams. Maneuver the cleaner until it is supported by the mounting flange. Do not release the cleaner from the lifting device until after it has been secured.

3. Re-install the inlet transition piece with its gasket loosely. Align the face of the inlet transition piece flange with the flange on the feed pipe or valve. You may have to install and use jacking screws if the cleaner is sitting too low.

4. Align the accept outlet with the accept pipe and install the gasket and fasteners loosely. Loosely install fasteners on the support flange. Make any adjustments required to minimize the stress on the head or piping. Tighten all fasteners.

5. Re-install the middle and lower cones and attach the rejects hardware.

The objective of the installation procedure is to minimize the stress on all equipment. The head is very robust and the forcing the headers into alignment could cause them to fail.

NOTE re: PLASTIC NUTS – plastic nuts on plastic cone parts are convenient and cost effective but they must not be treated as nuts made from metal. The nut should be installed hand tight plus no more than 1/8 turn beyond the point where it bottoms out. Anything more will cause the threads of the cone to deflect and a subsequent failure when the pressure comes up in the cone. The joint includes an "O" ring – if there is a lot of leakage this is the item to address.

MECHANICAL MAINTENANCE

The effective operation of the cleaner is dependent on the condition of the cleaners. Mechanical inspections are necessary to maintain the cleaners in peak condition. We recommend that the cleaners be inspected at least every six months. To assist in evaluating the condition of the cleaners the following should be considered.

Installation Stress

Plastics, rubbers and elastomers cannot be installed in the same manner as metal. These materials will fail if they are installed under stress. Failures are usually soon after installation. They typically involve complete failure of the part or connection.

Follow specific supplier instructions to avoid installation stress. If there are any questions, contact the supplier for clarification.

The three most typical installation stress issues are: misalignment of parts, overtightening of components specifically plastic nuts, and inadequate cleaner support.

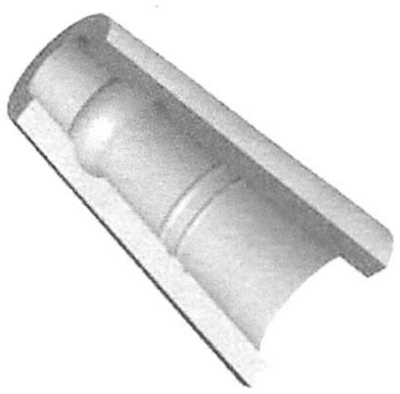
Reject Tip Wear

Stock is abrasive and with the high centrifugal forces encountered at the reject end of a cleaner the tendency is for the tip to enlarge over time. The worst wear is typically in the latter stages where debris is highly concentrated and reject tip expectancy is usually ¼ that in a primary stage.

A reject tip is worn out when the opening is enlarged 20% or more. At that point the rejects can become unmanageable without constant attention.

Ring / Orbital Wear

Ring / orbital wear is the most common cause of cleaner or component replacement.



Ring wear occurs when a hard object stays in one location in a cleaner cone and wears into the wall. The result is a ring worn into the wall of the cleaner. It can be detected by feel or by visual observation. Shine a light into one end of the cleaner while observing through the other. The ring will appear as a dark band.

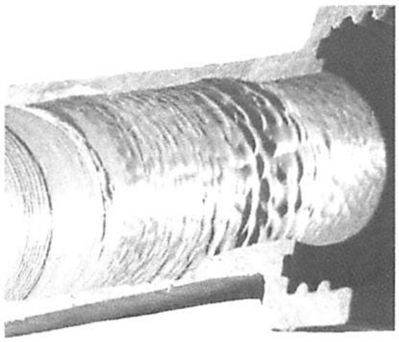
An object will be trapped in a single location for several reasons. The cleaner could be plugged. When this occurs, the cleaner will fill to a specific point but no further. An object will then orbit at the location immediately above the plug. The object may be too large to be rejected from the cleaner in which case it will settle into an orbit in a location where the forces within the cyclone balance out.

A single ring that is up to 1/8 inch deep does not affect the performance of the cyclone and shouldn't reduce the service life. If the ring is deeper or is there is more than one ring in close proximity, the cleaner / component should be discarded.

Some ring wear is preventable. Cleaners should be unplugged as soon as a plug is detected. A well balanced cleaner system will reduce instances of trapped particles orbiting in a given plane due to poor reject flow.

Washout

A typical new cleaner has a smooth inner surface. Some have reject control features that appear as vanes or rifling near the reject end of the cleaner.



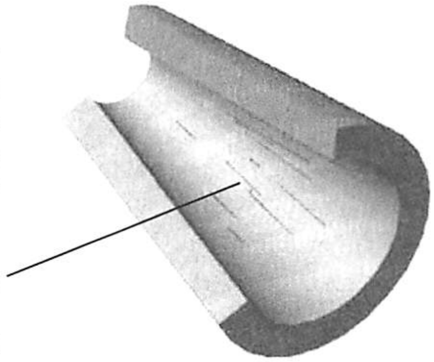
Washout resembles sandy river bottom. It is an indication that the cleaner is wearing normally and usually occurs after a long service life. Chemical attack can accelerate the process.

Washed out areas can be detected by feel or visual means. A thorough inspection should be done visually. Shine a light source in one end of the cleaner cone and observe through the other.

Washed out areas that comprise more than 5% of the cone interior can have a depth of 1/16 inch before cleaner operation is affected. Any cone that exceeds this area or has this area with more washout depth should be discarded.

Environmental Stress Cracking

Cracks that run in the axial direction on the inner surface of the cleaner are indicative of environmental stress cracking. The stress is provided by the internal pressure of the cleaner (typically equal to the feed pressure) and environmental damage by chemical or thermal degradation of the material.



The cracks penetrate the wall of the cleaner and will cause failures by splitting the cone along the axis (crack propagation). A cleaner or component should be discarded if any of these cracks appear.

Recommended Spare Parts

ELP Bigshot with ELP Urethane Lower Cone:

Part Number	Description	Quantity
ELP 12301	ELP 2400 Lower Cone	5
ELP 06005	Lower Cone Nut	5
ELP 06010	4 ½" "O" Ring 2-245	5
ELP 12304	ELP 2400 Middle Cone	2
ELP 12313	ELP 2400 Upper Cone	1

ELP Bigshot with ELP Flanged Middle Cone:

Part Number	Description	Quantity
ELP 12304	ELP 2400 Middle Cone	2
ELP 12383	Flange for Ceramic Cone	2
ELP 12384	4 ½" "O" Ring 2-425	5
ELP 12313	ELP 2400 Upper Cone	1

Other Maintenance Items

Additional service items around the cleaner system:

- Pressure Gauges
- Sight Glasses & Connectors
- Pumps
- Valves
- Headers & Piping

CLEANER SYSTEM OPERATION

Principle of Operation

Stock entering the cleaner will follow the wall and form a vortex. As it encounters more stock at the entry the flow is forced down the wall and into the cone section of the cleaner. As the flow becomes more constricted by the cone the portion closest to the center will reverse direction and spiral up the cleaner to be captured by the vortex finder. This stream exits the cleaner as the accept. The flow at the wall of the cleaner cone continues down the length of the cone and exits through the reject. This reject stream will contain the heavy contaminants along with a portion of the fiber.

Definitions

Feed Flow Rate is the volume of stock that enters the cleaner through the feed nozzle. Since it is difficult to measure it directly we use the pressure drop as an indication. For any practical purposes the equation as follows holds true:

$$Q_{FEED} = \text{"k"} \times \sqrt{\Delta P}$$

where: Q is the flow rate, "k" is a constant which depends on the cleaner model and units for both flow rate and pressure and ΔP is the difference between the feed and accept pressures.

Reject Rate by Volume – is the percentage of the feed flow rate (volume) that exits the cleaner through the reject.

$$RR_{(VOLUME)} = Q_{REJECT} / Q_{FEED} \times 100\%$$

Reject Rate by Mass – is the percentage of the feed solids (fiber, filler and debris) that exits the cleaner through the reject.

$$RR_{(MASS)} = tpd_{REJECT} / tpd_{FEED} \times 100\%$$

Cleaning Efficiency – is the percentage of the debris in the feed that exits the cleaner through the rejects.

$$\eta = \text{debris in reject} / \text{debris in feed} \times 100\%$$

there are various formulas used to calculate the debris removal efficiency. The most correct is to use debris counts vs. time but more often a simplified formula giving decent relative results is used. For more information contact ELP.

OPERATING TARGETS

To optimize the operation of a cleaner system we must look at three target ranges that are in our control. One is the feed flow into the cleaner, the second is the flow split within the cleaner and the third is the consistency of the stock. Each has a significant influence on the cleaners ability to remove debris.

Other influences are typically minor. Chemicals and pH levels do not have a significant influence on cleaning but they can have a significant influence on cleaner life.

Feed Flow Rate

Cleaners in general require a minimum feed flow rate in order to form the vortex on which cleaning relies. At less than this flow the vortex may form intermittently or not at all. Cleaners also have a maximum value over which turbulence inside the cleaner will affect performance, or the stock may not be inside the cleaner for a sufficient time to clean or there will be a loss of control over the rejects from the cleaner.

The target range of feed flows can be stated as flow or as pressure drop:

Feed Flow – 560 to 860 usgpm (2125 to 3250 lpm)
Δ P ($P_{FEED} - P_{ACCEPT}$) – 15 to 35 psi (105 to 240 kPa)

Flow Split (Reject Rate)

Flow entering the cleaner is divided into two streams. The flow that exits the cone end of the cleaner is the reject, the flow exiting at the wide end is the accept. The description used to describe the flow split is the reject rate – the percentage of the feed that exits by way of the reject. It is generally expressed as a rejects by flow (volumetric reject rate) or rejects by mass. For the purposes of Bauer & Bigshot cleaners, mass rejects is preferred.

We can discuss two ranges, one within the other. The optimum range for reject rate by mass is 18 to 22%. At this reject rate we can expect to see the highest cleaning performance for the cleaner. The full range of reject rates for the Bigshot starts at 8% and goes as high as 25%. This is the range in which the cleaner can operate without significant operating problems such as plugging.

There are other considerations when setting the reject rate of a stage of cleaners besides the optimum range for cleaning efficiency. We must also consider the influence that the rejects has on the following stages as well as on the overall fiber loss at the end of the system.

Finally the volumetric reject rate should be considered. We should not let the reject rate by volume become too low to prevent plugging issues. A practical lower limit is about 3% of the feed flow rate (range ~ 12 to 25 gpm per cleaner).

Feed Consistency

In general, the cleaner performs best when the consistency is in the range of 0.3 to 0.55% feed consistency. Performance starts to decline gradually after 0.6% then more abruptly after 0.8% feed consistency. At 1.2% feed consistency, the dirt removal efficiency for all but the most dense particles is almost gone.

Primary stage feed consistency is normally a function of the equipment following the cleaners. A typical requirement can be headbox flow and consistency. Secondary and later stages feed consistencies are adjustable by controlling the reject rates of all stages.

It is generally desirable to have the feed consistency decline from stage to stage but this is not always possible. A stage that is smaller in terms of volumetric flow rate can have a higher feed consistency than previous stages and yet be at an optimum balance.

MEASURING SYSTEM OPERATION

A flow balance (or cleaner system audit) is the easiest means of determining whether the cleaners are operating inside their target ranges. This typically requires that a number of consistency samples, pressure readings and flow rates be determined and the results calculated. There are three readily available methods for these calculations – the attached Excel spreadsheet uses an iterative process and key data points to determine the results. Discussion of the flow balance will refer to this spreadsheet.

The spreadsheet is divided into three sections. The first is the RESULTS section where the calculated pressure drop and reject rates are shown along with the full range for the pressure drop and the recommended range for the reject rate. The next section is the DATA INPUT section. A number of cells are highlighted. These are the required inputs. There is additional data presented for reference – a copy of each balance should be kept to determine long term trends. The third section is the flow diagram. The majority of the calculations are done here.

The calculation is iterative so that function must be turned on (tools, options, calculation, iteration). The preset values are adequate.

Measuring System Operation

1. Using the spreadsheet as a guide, gather the data in the highlighted cells.
2. Overwrite the data in the cells – do not delete and add. The sheet as sent is set to calculate automatically and you will end up with #DIV0 in several locations.
3. Print the spreadsheet.
4. Determine what actions are required and in what order they should be done. Consider the best time to do them and put them into effect.
5. If significant changes are made to reject rates or a pressure drop is changed the process should be repeated.

Required Data

The required data is as follows:

- All feed consistencies, the makeup (pump dilution) water consistency and the final stage reject consistency.
- All feed and accept pressures.
- The final stage reject flow to sewer. A reasonable estimate can be applied if a direct measurement is not available.
- Any miscellaneous data as shown in a highlighted cell.

Temperature is applied throughout the system. It's shown as a required input but can be a reasonable estimate.

Actions

Once the data has been entered into the spreadsheet, print a copy for evaluation. Evaluation should proceed as follows:

1. Check the pressure drops against the range shown and against any available historical values.
   - check the pressure gauges
   - check valve positions

2. Check the reject rates against the recommended ranges.
   - note any that are high or low and the amount of adjustment to be made. Note these as increases or decreases.

3. Check the diagram for problem areas.
   - check to see if there any back flow instances in the makeup water. A back flow instance is generally a consequence of poor reject rates or pressure drop but does underscore the importance of keeping the system in balance.

Once the actions are determined they should be set in order. The specific criterion is to not make things worse:

4. If possible modify the feed flow rate of any stages where this action is required.
   - note that an increase in feed flow will reduce the reject rate of that stage.
   - expect that changing the flow rate will affect more than one pressure
   - expect to need another flow balance to confirm results.

5. Increase reject rates where required starting at the last stage and working toward the primary.
   - starting at the end of the system minimizes the chances of an increase in consistency plugging any given stage
   - increasing the reject rates before decreasing reject rates as in 6 below reduces the chances of plugging.
   - increasing the reject rate generally requires an increase in accept pressure or a decrease in reject pressure. The change in pressure should be measurable by the

pressure gauge. For small adjustments ½ psi is a standard until more accurate data for adjustments is available.

6. Decrease reject rates where required starting at the primary and working toward the final stage.
   - starting at the front of the system reduces the chance of plugging since consistencies will be reduced in later stages by this action.
   - decreasing the reject rate generally requires a decrease in accept pressure or an increase in reject pressure. The change in pressure should be measurable by the pressure gauge. For small adjustments ½ psi is a standard until more accurate data for adjustments is available.

Once the order for adjustment is determined make the changes. If the adjustments are minor – no change to pressure drop and < 5% adjustments on reject rates – the process is done. If the adjustments are more significant or to confirm the effectiveness of the adjustments made a subsequent flow balance may be done.

Keep a copy of the spreadsheet for future reference and to determine long term trends.

Once a good balance is found measure the valve positions and pressures that produced this balance. These can be noted on the spreadsheet. The value of these is that it gives a good starting reset position for the system.

Flow Balance Frequency

We typically recommend that the system balance be checked monthly. If it is found to be chronically out of balance each month then the frequency should be greater. If the balance is very stable the period may be extended.