THE ABRASIVE SEPARATION SYSTEM

BY

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All blast systems in the compressed air or centrifugal wheel categories designed for shot peening have 5 major characteristics in common.

1. The propelling device – whether they are blast nozzles or blast wheels.
2. Dust Collection System for keeping the environment safe for the plant and operator. This normally supplies the power for the abrasive separation system.
3. Material on Work Handling System to efficiently present the part to be peened to the blast streams.
4. Abrasive Recovery System to be able to reuse the spent abrasive for another blast cycle.
5. Abrasive Separation System to clean the abrasive for reuse by different means, this may require separators for sizing as well as shape control.

This paper will concern itself primarily with Item number 5 – the Abrasive Separation System.

SIZE CONTROL

There are a number of methods here available to the equipment supplier. Depending on the amount of abrasive that has to be recovered and recycled, some of these methods are not practical.

Compressed Air Systems, depending on the abrasive size and density, may be able to use pneumatic recovery, which incorporates a cyclone type separator. The cyclone imparts centrifugal force on the particles where the heavy particles fly to outside of the chamber, and the fine particles move to the
inside and eventually out with the exhaust air. The cyclone is dependent on flow rates, particle sizes and densities of the abrasive to be reclaimed.

See attached generic write-up for cyclone function.

When the recoverable abrasive amount gets large in quantity or density, the recovery system probably then incorporates longitudinal screws and bucket elevators for recovery. The separation system normally incorporates airwash separators. The size (length) inches is dependent on the abrasive load and the contaminate load. Each manufacturer seemingly has his own design, which all try to separate contaminatees, as well as sizes of abrasive. It should be noted there is no oversize protection.

See attached sheets on the Jet Wheelblast Airwash Separator and Rotary Drum Screen with Airwash Separator sheets for further explanation on how these units operate.

Additional size control can come from external screeners. These come in vastly different designs to perform the classifying function. You can also utilize an additional deck here for oversize screening should your process warrant it.

Gyratory (Vibratory) round type screens 18" to 72" in diameter. These units generally have controls for adjustments to amplitude (the degree of vibration), lead angle adjustments to help create flow patterns across the screen and some equipment offers RPM controls to change the frequency of the vibratory units.
Two of the leading manufacturers here have been SWECO and MIDWESTERN.

Vibratory Rectangular type units are also manufactured and used in sizing of abrasive. These units are of a different size and work slightly different than the round type, but perform the same function. Some of the major manufacturers here are ROTEX, Combustion Engineering and SMICO.

Concerns that have to be addressed with the vibratory screeners is the mass or flow rate required to be screened or classified, maintenance for the screener, and of course, maintenance of the screens to eliminate blinding of the screen.

I purposely left out a more involved discussion of the vibratory screeners because there will be speakers here that will cover those fields directly.

Shape guarantee for roundness is generally taken care of in what's commonly called a spirolator. See the Cleland Manufacturing Company sheet attached. These spiral separators are built again for a size of abrasive, as well as a specified feed rate.
Some applications notes for the Cleland Spiral Separator are as follows:

<table>
<thead>
<tr>
<th>SIZE SPIRAL</th>
<th>SIZE SHOT</th>
<th>FLOW RATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 - 3 1/2&quot; FLIGHTS</td>
<td>S 70</td>
<td>20#/MIN</td>
</tr>
<tr>
<td>4 - 4 1/2&quot; FLIGHTS</td>
<td>S 110</td>
<td>30#/MIN</td>
</tr>
<tr>
<td>5&quot; FLIGHTS</td>
<td>S 170</td>
<td>35#/MIN</td>
</tr>
<tr>
<td>6&quot; FLIGHTS</td>
<td>S 230</td>
<td>38-45#/MIN</td>
</tr>
<tr>
<td>6&quot; FLIGHTS</td>
<td>S 330</td>
<td>38-48#/MIN</td>
</tr>
<tr>
<td>6&quot; FLIGHTS</td>
<td>S 390</td>
<td>38-48#/MIN</td>
</tr>
<tr>
<td>6&quot; FLIGHTS</td>
<td>S 460</td>
<td>38-45#/MIN</td>
</tr>
</tbody>
</table>

- Double Spiral Units can be connected in series for additional capabilities;
- Single Spirals have 4 inner working flights and the capacity is 40% of the double (same size);
- Glass shot usually runs about 20 to 25% slower than steel shot.

With regard to equipment design for separation system. It is highly suggested that the separation system for sizing and shape guarantee be reviewed with the vendor and customer, to a very high degree. Decisions have to be made as to the degree of screening needed, how much material per pass needs to be classified and/or spirolated.

High production units may not be able to classify or shape screen 100% of the time. The classifying percentage required could become a very large dollar item in some machine designs.
As always, proper maintenance to the machine, especially the abrasive separation system, is required. Without it, size and shape guarantee goes away, and with the loss of proper abrasive (work mix) control, your shot peen intensities and coverage requirements will be in JEOPARDY.
PRINCIPLES OF OPERATION

Contaminated dust filled air enters the cyclone at a tangential inlet. This inlet induces the dirty air to start spinning in a circular motion. As this spinning dirty air drops into the ever-decreasing cone diameter, the spinning increases in velocity. This spinning throws heavier and heavier particulates to the outside of the cone. At the bottom of the cone, the "cleaned" air stream separates and the collected dirt falls into a storage container. The "cleaned" air then passes out of the cyclone at the top.

The cyclone gets its power from a fan which either "pushes" dirty air into the cyclone, or "pulls" the cleaned air from the cyclone. Generally, the smaller the main cylinder diameter for given CFM, the higher the cyclone efficiency. Particulate size is also an important consideration.

Cyclones are generally sized as a function of either the inlet size, or the main body cylinder diameter.

All of the other diameters, lengths, etc, are some value of these size functions.
The machine is equipped with an airwash separator for separating the impurities from the usable abrasive. The system works in the following manner:

The abrasive and contaminants are discharged into the stow hopper by the elevator. The abrasive and contaminants accumulate behind the counterweighted swinging baffle. When the pressure of the abrasive exceeds the retarding action of the counterweight, the swinging baffle opens permitting the contaminated abrasive to flow uniformly over the entire width of the plate. This flow creates an abrasive curtain along the full width of the separator, falling over the lip of the distributing plate and into the air current created by the suction of the dust collector fan. At this point the abrasive is in the cleaning zone and contaminants such as dust, scale and unwanted fines, etc., are removed from the abrasive mixture by the air.

The adjustable gate in the ventilation line regulates the air velocity through the abrasive curtain. By adjusting the velocity of the air, the size of the particles to be removed may be controlled. The greater the velocity, the larger the size of particles removed. The adjustable skimmer plate is used for the purpose of dividing the reusable abrasives and the contaminants so that each is directed into its proper area. The deflector plate directs dust laden air into the expansion chamber. Once in the expansion chamber, the coarse contaminants fall out of the air stream and into a dribble pipe. The dust laden air continues into the ventilation line and is conveyed to the dust collector. The cleaned abrasive falls through the scalping screen and into the abrasive storage hopper.
The function of this system is to separate impurities from the reusable abrasive. This is done with a rotary drum which removes large contaminants, an air wash system which removes small contaminants, and a removable trash screen which traps any material too small for the rotary drum but too large for the air wash. The abrasive resistant steel rotary drum is fed from the elevator by a tubular screw conveyor. The contaminated abrasive falls into the rotary drum, and particles too large to fall through the 3/16" x 3/4" staggered slots are conveyed along the internal helix and discharged from the end of the drum into the coarse refuse flex hose. Contaminated abrasive which does fall through the rotary drum is distributed longitudinally in the stow hopper behind the swinging baffle by the external helix.

The second stage of separation, the air wash system, now becomes effective. The abrasive and contaminants accumulate behind the counterweighted swinging baffle. When the pressure of the abrasive exceeds the retarding action of the counterweight, the swinging baffle opens permitting the contaminated abrasive to flow uniformly over the entire width of the horizontal distributing plate. This flow creates an abrasive curtain along the full width of the separator, falling over the lip of the distributing plate and into the air current created by the suction of the dust collector fan. At this point the abrasive is in the cleaning zone and contaminants such as dust, scale and unwanted fines, etc., are removed from the abrasive mixture by the air.

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The image shows a diagram of the rotary drum screen with air wash separator. The diagram illustrates the key components of the system, including the rotary drum, air wash system, and removable trash screen.
THE ORIGINAL CLELAND DOUBLE SPIRAL SEPARATOR

FOR VARIOUS AGRICULTURAL AND INDUSTRIAL APPLICATIONS

The Cleland Spiral Separator is the most successful method of separating round product from cracked, broken, irregular shaped material. Each unit has ten separating inner flights. Round product separates into two grades, portions of which can be controlled by an adjustable deflecting wing. Left or right round discharge is optional to facilitate round product to be discharged in the same area when utilizing more than one unit. The Cleland Spiral Separator is available with a self-cleaning hopper to ensure total emptying of the top hopper bin.

Separates Anything Round From Anything That is Not Round

Requires No Power

Operates By Gravity

The Cleland Spiral Separator is successful in separating a variety of seed, such as Soybeans, Vetch, Peas, Pepper, Rape, Turnip, Coriander, Milo, Mustard, etc. from Wheat, Oats, Barley, Flax, Screenings, etc. Capacities for these and other applications are available upon request.

Industrial applications include separation of various types of shot and glass beads, etc. Write, phone, or fax for capacity data on these materials.