TROUBLESHOOTING COMMON VIBRATORY SEPARATOR ISSUES

This article focuses on some of the issues that people in the powder and bulk solids industry face when screening material with round vibratory separators. This article discusses different concerns associated with vibratory separators, the cause of the issues, and solutions for remediating these challenges.

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Vibratory separators, also known as screeners, are used by many for applications in the powder and bulk solids industry. As the name suggests, vibratory separators separate bulk materials by particle size; however, as the equipment ages and experiences wear and tear, you may find yourself running into issues with the machine. Most of the time, troubleshooting can help solve these concerns. Many separator problems can be easily fixed with simple adjustments or changes to the machine’s components. Premature screen failure, screen blinding, and irregular material movement are a few of the most conventional — and easily fixable — issues that separators experience. Here we’ll discuss these issues, what causes them, and how to resolve them.

Premature screen failure

One of the most common problems that operators face with their vibratory separator is premature screen failure. Vibratory separator screens are considered a wear item in that they’ll eventually wear out and need replacing. Unfortunately, a screen’s life is dependent upon many variables, such as the material type it comes into contact with, any environmental extremes, cleaning methods used with it, etc., so it’s not easy to say how long a separator screen should last without taking those factors into consideration. However, you should get plenty of use out of your screen before needing to replace it.

Delamination. There are many possible causes for premature screen failure. If a screen is delaminating or separating into layers on the tension ring, this could indicate a temperature issue. Every screen manufacturers’ temperature limits differ for epoxy-mounted screens. Some limits are as low as 120°F (49°C) while others are as high as 200°F (93°C). If the material temperature exceeds the screen’s limit, the epoxy will begin to weaken and fail, causing the screen to delaminate. The pH level of the materials being processed also needs to be taken into account, as it affects the screen. Materials with a high pH level of 10 or more tend to decrease the epoxy’s temperature resistance, causing a screen to delaminate even at temperatures within the manufacturer’s given limits. If you think you might encounter this problem because your process requires separating materials at a high temperature greater than the screen manufacturer’s limits, consider using a welded screen if possible. A welded screen can withstand temperatures up to 400°F (204°C). This screen type isn’t always an option for food and other sanitary applications, so be sure to speak with the screen manufacturer to find out about other options; however, these same issues can occur with differing screen types.

Breakage. The center of the separator screen is another focal point for premature failure. To minimize the risk of screen failure at the center of the screen, there are a few things that should be checked. If working with a larger screen that uses a center tie-down, ensure that the tie-down is holding the screen level. An unlevel screen could put unwanted stress on the mesh around the center disc, causing the screen to tear. Also, make sure the center tie-down assembly is tightened properly. The assembly should only be tightened after the exterior clamp ring assembly is seated and fully torqued. If tightened incorrectly, this too could put added stress on the screen mesh, leading to early screen failure. The screen’s center should also be watched to ensure material doesn’t congregate there. If this happens, the screen mesh will wear at that point, leading to breakage. An incorrect lead angle is the likeliest cause of center congregation. The lead angle is the number of degrees separating the motor shaft’s bottom weight assembly resultant force and the top weight assembly resultant force. To fix an incorrect lead angle, the weight settings and lead angle need to be.
adjusted to move the materials off the screen. Another common reason for center screen failure is a feed surge to the screen. When this occurs, the screen’s center is flooded with material, and the weight of the material compromises the integrity of the mesh, causing the screen to tear or wear out. To eliminate this possibility, the vertical drop of the feed can be reduced for dry applications or a velocity reducer can be installed for wet applications, including slurries.

The screen can also fail along the inside diameter of the mounting ring, but you can troubleshoot this issue by checking on a couple of things. First, make sure the material feed isn’t surging onto the screen. If it is, tailor the process as previously mentioned to accommodate the kind of materials being worked with (dry versus wet applications). These resolutions help limit the stress on the mesh from the added weight of the material feed. Second, check to make sure that oversized materials aren’t building up on the screen deck. It’s imperative that oversized materials discharge properly. If you’re experiencing a problem with oversized-material discharge, adjust the lead angle on the bottom weight assembly to assist in facilitating material discharge.

Depending on your process needs, it might be beneficial to invest in one or more specialty or customized screens to fit the application of the materials being processed. Consult with your separator provider to see what can be done to help avoid premature screen failure or simply get a longer life out of your screen.

**Screen blinding**

Another common problem that many operators encounter with their vibratory separator is the screen mesh blinding or plugging due to the makeup of the materials being processed. Blinding primarily occurs in one of two ways. When a percentage of the material is close in size to the screen mesh hole aperture size, that material tends to get lodged in the holes; this material is referred to as *near-size*. Near-size materials tend to lodge in the screen’s mesh holes, blinding the screen mesh and prohibiting additional materials from passing through the screen, as shown in Figure 1. Blinding also occurs when dealing with materials that may be sticky or full of static. These material particles tend to adhere to the screen mesh itself, building up around the wires. The buildup will slowly lessen the hole opening size and eventually close it entirely, preventing additional materials from passing through the screen, as shown in Figure 2.

**Bottom-side self-cleaning kits.** Several screen cleaners or antiblinding devices are available to counter screen blinding, and they come at a reasonable cost. One such device is a *bottom-side self-cleaning kit* displayed in Figure 3. This device is made up of

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**FIGURE 1**

Near-size material blocks the screen mesh hole aperture

**FIGURE 2**

Sticky or staticky material blinds the separator’s screen

**FIGURE 3**

Sliders are used to clean vibratory separator screens
a perforated plate mounted below the screen surface with *sliders* placed between the perforated plate and the working mesh. The sliders are individual plastic rings that, when stimulated, travel radially around the separator’s screen. The sliders keep the working mesh clean by tapping out or shearing off lodged, near-size materials that tend to blind the screen and reduce screening area. Self-cleaning kits are the most commonly used screen cleaners, and sliders are one of the least expensive cleaners that require minimal maintenance. One disadvantage to using a self-cleaning kit is the added noise level generated from the sliders constantly tapping on the metal perforated plate. However, noise-abating perforated plates are available and can significantly reduce the decibel levels compared to the standard kits’ perforated plate.

A *ball tray* is another bottom-side self-cleaning device, which uses various types of balls instead of sliders. Elastic balls, like the ones in Figure 4, are placed on a coarse screen, which is then mounted two inches below the sizing screen. The separator vibrates in action, which causes the balls to bounce against the working mesh’s screen underside, dislodging any near-size materials. Balls can be made of rubber, polyurethane, or silicon among other materials and are inexpensive. Like the sliders, the balls are noisy but also require minimal maintenance and are easy to replace when worn out; however, the balls have a tendency to migrate to the screen’s periphery and neglect the screen’s center.

A third option, which is a mix between the slider self-cleaning kit and the ball tray, is the *self-cleaning screen*, shown in Figure 5. A self-cleaning screen is comprised of a working mesh on top of the tension ring with a coarser mesh (support screen) attached to the bottom of the ring. Depending on the application and how much cleaning action is needed, sliders or sliders and balls are placed between the working mesh and the coarser mesh. Once the machine is in operation, the sliders or sliders and balls bounce off the support screen and tap the top screen, dislodging the near-size materials. The moderately priced, easy-to-maintain self-cleaning screen does a better cleaning job than the self-cleaning kits and ball trays because of the sandwich-type setup of the top and bottom screens. Also, because the sliders and balls bounce off a mesh screen instead of a perforated plate like the self-cleaning kit uses, the self-cleaning screen runs at a much lower decibel level than the self-cleaning kit, so it is more tolerable during operation; however, it is still recommended that you wear hearing protection while operating the cleaners.

**Top-side self-cleaning kits.** Opposite of the bottom-side self-cleaning kits are *top-side self-cleaning kits*. These devices are primarily designed for use in dry powder applications to break up materials while assisting them through the screen. Top-side self-cleaning kits are less commonly used than bottom-side cleaners and are typically used when standard sliders or balls won’t work. Top-side self-cleaning devices provide a lightweight scrubbing action on the screen’s surface to keep dry materials from sticking to the wires and improve material yield through the screen. Top-side self-cleaning devices also act as barriers to the material discharging from the machine, which results in longer material residence time and improved efficiency. *Efficiency* is the percentage of on-specification materials extracted from incoming feed materials during the screening process.
One specific top-side self-cleaning kit is the *wiper ring self-cleaner*, shown in Figure 6. The wiper ring self-cleaner is made up of sliders that form a shape similar to spokes on a wheel. As the separator vibrates, the wheel of sliders rotates around the separator screen, shearing material through the mesh openings and breaking up material as it moves. Along with operating fairly quietly, the wiper ring is inexpensive and requires very little maintenance.

Similar to the wiper ring self-cleaner is the *top-side necklace ring dam*, also referred to as a *wiper wheel*. The necklace ring dam is made up of plastic rings linked together via a stainless steel or polyurethane cord; aligned at the separator screen’s periphery, this configuration forms a dam or one large ring. The separator’s vibrations cause the rings to move quietly around the screen, giving larger particles more opportunities to pass through the screen. The relatively inexpensive necklace ring dam requires minimal maintenance and provides material yield similar to that of a larger machine.

Another quiet-operating top-side self-cleaner is a *rotary brush*. Four narrow, plastic-bristle brushes are assembled on a round frame 90 degrees apart from one another. This contraption rests on the screen itself and moves with the separator’s vibrations, cleaning the material off the screen as it goes. One drawback to the rotary brush is that it’s fairly expensive when compared with bottom-side cleaners. Also, bristles from the brush can fall into the material stream and contaminate it, so the bristles must be cleaned intermittently.

**Additional screen-cleaning devices.** Not included under the umbrella of bottom- or top-side self-cleaners are application-dependent remedies for screen blinding. For dry applications, *ultrasonic systems* are an available accessory to enable fine mesh screening. Ultrasonic systems have the ability to screen fines down to 20 microns, as opposed to many separators that process dry material down to 50 to 80 microns. The system enhances screening by creating a low-amplitude, high-frequency, secondary vibration on the screen’s surface, as shown in Figure 7. This improves the performance of fine mesh screening of both low- and high-density powders and even materials carrying an electrostatic charge. While quiet in operation and useful in high-accuracy screening applications, the ultrasonic system is 10 to 20 times the cost of sliders and balls. Ultrasonic system maintenance includes replacing the transducer on the tension ring during screen replacement, which can be costly.

Another dry application screen cleaner is the *vibrating rim cleaner*. Metal ball bearings are inserted into the hollow screen tension ring that holds the separator screen. When the separator vibrates, the ball bearings bounce and hit the ring’s interior surfaces, resulting in secondary vibrations rippling out to the screen area closest to it, which assists the material there through. The vibrating rim cleaner is better for cleaning synthetic screens that are easily damaged by sliders and balls; however, since the secondary vibrations ripple out from the edge, they unfortunately only clean a 2-inch area around the screen’s outer edge. Vibrating rim cleaners don’t require any maintenance because the ball bearings are encased, but they are moderate in cost and noisy to operate.

There are several ways that a separator screen becomes blinded, but there are also several ways to counteract this issue. It’s just a matter of finding the appropriate antiblinding method that best fits your application.

**Irregular material movement**

Another issue that vibratory separator operators experience is that material on the screen moves in an...
irregular direction or not at all during processing. For example, the material may stay in the middle of the screen and not discharge, run opposite of what it normally does on the screen, or instantly move to the screen’s perimeter once fed into the machine. There could be any number of reasons why these irregular patterns form. In some cases, these situations may call for a seasoned professional to come fix the issue. Someone with a lot of experience with round separation equipment could dial in the appropriate settings for any separator to make it run at its optimal efficiency. However, before calling in an expert, there are a few corrective actions you can consider to make sure the machine is set up correctly or at least within its standard parameters, which could potentially fix the issue.

**Lead angle and motor rotation.** A typical round vibratory separator is driven by a double-shaft motor installed in the vertical position. Affixed on the upper and lower motor shaft is a weight assembly that produces a centrifugal force when the motor shaft spins. When looking down at the motor from above, you should be able to see the lead angle, which is the number of degrees separating the motor shaft’s bottom weight assembly resultant force from the top weight assembly resultant force. The lead angle is the most important factor in what determines materials pattern on the screen surface. Keep in mind that the separator’s vibratory motion is controlled in two directions. The upper weight assembly controls the horizontal amplitude while the bottom weight assembly controls the vertical amplitude. The lead angle is adjusted at the bottom weight assembly and can be set at an angle anywhere between 0 to 120 degrees. Changing the lead angle will facilitate a material flow pattern change on the screen, as demonstrated in Figure 8. A higher lead angle will produce a more spiral pattern on the screen, resulting in longer material retention time. So, for materials where it’s difficult to separate the fines from the oversized material — because the material is close in size to one another or it agglomerates easily — a higher lead angle for a longer retention time would be required. For an application where the materials are easily separated, but you need the materials to quickly move off the screen, a lower lead angle should be used. A 35-degree lead angle is the most typical setting for a standard separator in a one- or two-deck configuration, but all applications and materials are different and require a fair amount of testing to determine the best arrangement.

If materials are running in the opposite direction of how they usually run on the screen, check the rotation of the motor. The motor should be running counterclockwise when looking at it from the top down, or the counterweight assembly should move left to right when viewing through the base door. If the motor is running clockwise or the weights are moving right to left, the motor rotation is wrong, and the motor leads will need to be reversed in the control box.

**Other miscellaneous factors.** Lead angle and motor rotation are the most common driving forces affecting how material moves in a vibratory separator. However, there are other factors that could influence the motion of the separator, which impacts the screen’s material pattern. For instance, if there’s not enough tension on the screen and it’s loose, this will affect how the materials move on the screen, which in turn affects separator throughput and efficiency. If you have a loose screen due to a lack of tension, consider replacing the screen so that your throughput and efficiency don’t suffer.

Additionally, if the separator isn’t level, it could affect the material pattern. Make sure the separator is level when installed.

If the weight around the separator’s perimeter is not evenly distributed, the material pattern will be affected. Ideally, the discharge spouts on the screen deck’s frame need to be 180 degrees apart (opposite
each other) for a single-deck machine, as shown in Figure 9, so that the weight is evenly distributed. On multideck configurations, all the discharge spouts should be evenly spaced around the machine.

Feeding material onto the screen off-center will also affect how the material moves on the screen. To avoid this, be sure to feed material to the separator in the center of the screen.

If any of the springs on the separator are missing, broken, or worn, this will affect the materials pattern. You’ll need to replace any problematic springs immediately, which can be easily done through the separator’s manufacturer.

Irregular material movements can be due to any number of problems, and it may not always be easy to discern the problem’s source. However, keeping the information discussed here in mind will help you be better prepared to troubleshoot this kind of issue to resolve it on your own should it arise.

**Conclusion**

Owning and operating a vibratory separator is generally a smooth experience…until it’s not. Whether you encounter premature screen failure, screen blinding, irregular material movement, or something entirely different, it’s a sure bet that the issue that crops up will negatively influence the separator’s efficiency and throughput. The preceding information was just a few tricks of the trade to look out for when your vibratory separator equipment isn’t performing optimally, although it doesn’t cover all scenarios. Keep in mind that general advice is no substitute for having the separator manufacturer’s experts come on-site to diagnose and resolve a separator problem in person.

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**For further reading**

Find more information on this topic in articles listed under “Screening and classifying” in *Powder and Bulk Engineering’s* comprehensive article index in the December 2019 issue or the Article Archive on *PBE’s* website, www.powderbulk.com.

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**FIGURE 9**

The discharge spouts on this single-deck separator are opposite each other to keep a balanced weight.