Addressing wear and abrasion

Given the nature of the materials used in cement production, wear and abrasion of key pieces of equipment is a major concern. Selecting equipment that offers longevity of wear parts and unique designs for ease of maintenance is vital to minimise replacement costs and interruptions to the production process.

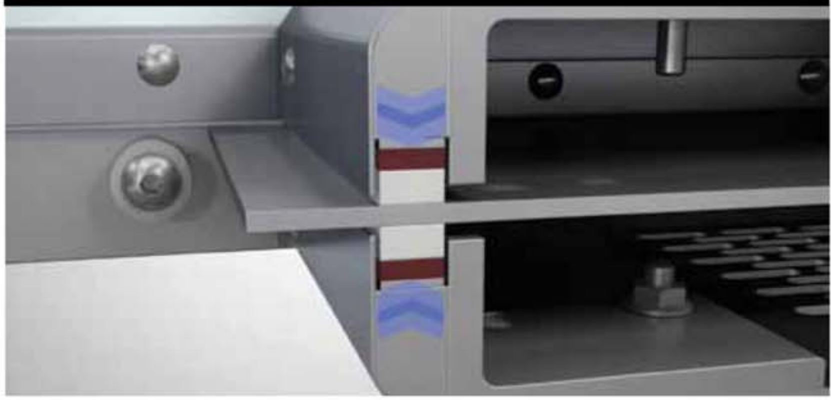
■ *by **Vortex Global,** UK*

Once processed as a finished product, cement is only moderately abrasive. During production, however, the raw materials can be quite harsh. Common materials used in cement production include bauxite, blastfurnace slag, clay, clinker, crushed stone, fly ash, gravel, gypsum, iron ores, limestone, shale and silica sand. Due to the hardness and toughness of these materials, rapid wear and abrasion to material-handling equipment is a concern.

Selecting the proper equipment is critical to the success of any cement manufacturing process. If machinery is ill-equipped to handle abrasive aggregates, many complications can result, including extreme wear to internal mechanisms, material leakage through the valve and to atmosphere, worn seals and actuation errors. If less-robust equipment is used to handle abrasive materials in high-volume environments, maintenance and replacement must be regularly performed.

Rather than facing these recurring expenses over time, investment can be made in well-designed material-handling equipment to provide durability and longevity in abrasive environments.

Figure 1: seals automatically compensate for wear, without maintenance intervention



Slide gates

The TSG gate by Vortex Global is specifically designed to allow high cycles and prolonged service life with minimal maintenance intervention, and offers the following benefits:

Wear-compensating seals

The TSG gate features live-loaded, wear-compensating bonnet seals constructed from hard polymer (see Figure 1). As the gate cycles, frictional wear between the blade and seals is compensated by compressed rubber backing on the seals. This ensures a constant seal that hinders material leakage and dusting to the atmosphere, even as the polymer begins to wear over time.

Easy in-line maintenance

Over time the bonnet seals can lose their compression load, causing material and dust to migrate into the gate's bonnet. Once this happens, the bonnet seals can be easily replaced while the gate remains in-line. Using simple tools, each access panel can be removed along the lateral aspects of the gate, and new bonnet seals

Figure 2: removable access panels and replaceable bonnet seals allow the gate to be serviced while in-line

can be driven into the gate while the worn seals are simultaneously ejected out the other side (see Figure 2).

Bonnet seals help limit material and dust from migrating into the gate's body. Materials can build up in the gate body and cause blade actuation errors.

Abrasion-resistant liners

The TSG gate is also equipped with replaceable abrasion-resistant liners at the gate's inlet (see Figure 3). The purpose of abrasion-resistant liners is to protect the gate's inlet, rollers and side seals from wear caused by the material stream. For added durability, the rollers are constructed from hardened steel.

To further protect the rollers and side seals, the TSG gate can be equipped with a special service inlet (see Figure 4), the purpose of which is to direct the material flow towards the centre of the gate's inlet. By doing so, a dead pocket is created to protect the gate's rollers from the abrasive material flow.

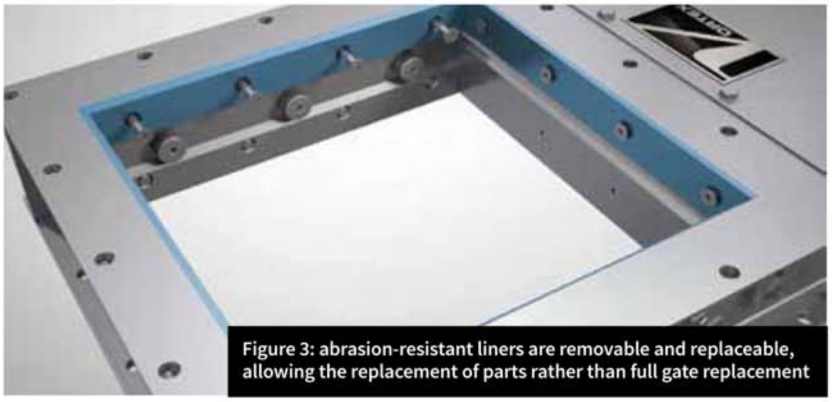


Figure 3: abrasion-resistant liners are removable and replaceable, allowing the replacement of parts rather than full gate replacement

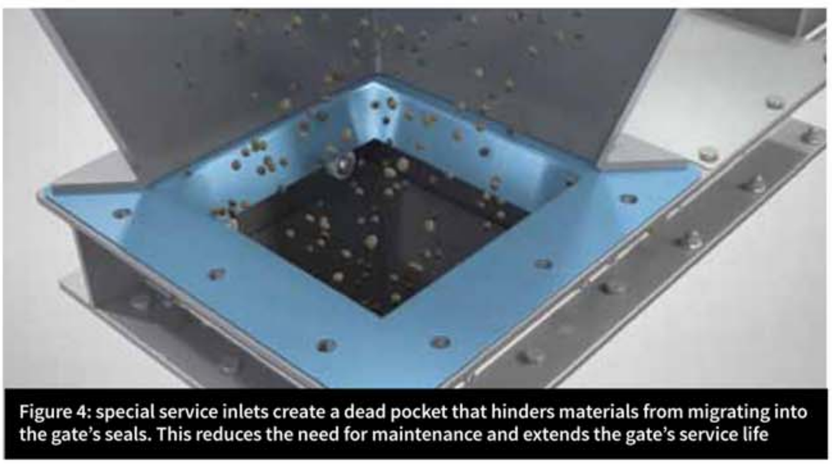


Figure 4: special service inlets create a dead pocket that hinders materials from migrating into the gate's seals. This reduces the need for maintenance and extends the gate's service life

Figure 5: the Vortex aggregate diverter's rubber bucket seal creates a positive seal across the closed chute to reduce material leakage to the opposite leg

Diverters

The Vortex aggregate diverter was conceived to address the many issues facing the cement industry when using typical flap diverters to handle concrete blends.

Traditional diverters are often built using standardised designs, without appropriate modifications to address the abrasiveness of cement production. As a result, they are almost constantly being repaired or replaced very early in their life cycle.

These maintenance issues cause frequent downtime and stalled production, negatively influencing overall performance. With these deficiencies in mind, the Vortex aggregate diverter was specifically designed for abrasion-resistance and prolonged service life.

Seals protected from blast abrasion

Ordinary diverters do not provide the necessary protection to the internal seals, causing them to prematurely wear and become ineffective. The Vortex aggregate diverter uses a highly-durable rubber bucket seal and is designed so that the leading edge of the blade enters into a recessed area (see Figure 5).

This design ensures that the rubber bucket seal is protected from blast abrasion as material flows through the inlet, which would otherwise cause the seal to rapidly erode. The aggregate diverter provides a positive seal across the opposite leg to prevent material leakage or dusting to the closed port. However, a disadvantage to flap- or bucket-style diverting is that cycle times are slowed as

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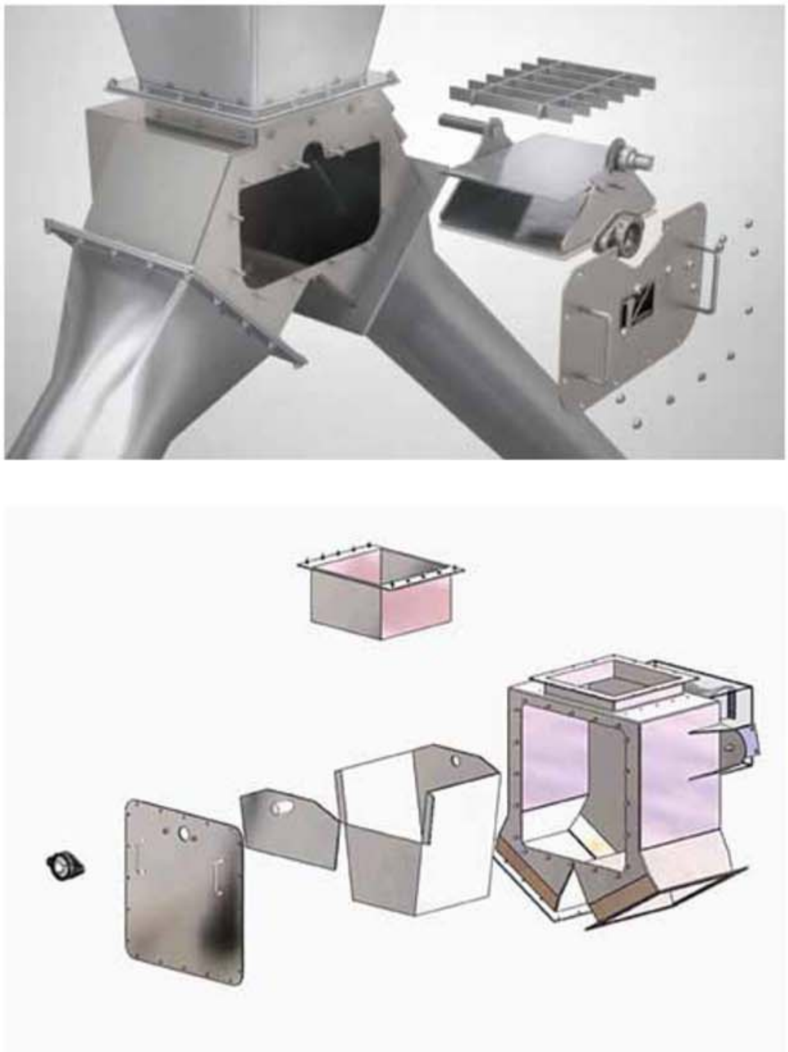
Figure 6: removable access doors and replaceable wetted parts allow Vortex diverters to be inspected and maintained while in-line



the material flow must be halted before the blade is shifted. With this in mind, Vortex improved the processing speeds while maintaining longer service life by designing the pivoting chute diverter.

Pivoting chute

The Vortex pivoting chute diverter features an independent, internal chute that pivots between the outlet legs. Unlike traditional flap and bucket diverters, the pivoting chute diverter can be shifted fully towards a single port, or partially to split the flow towards two destinations. Because the shifting of ports is a smooth process, changes in material flow pattern are subtle, which decelerates the rate of wear to the pivoting chute.

Easy in-line maintenance

Traditional diverters cannot be maintained while in-line. The entire diverter must be removed from service, which causes downtime and expensive diverter rebuild or replacement. Both the aggregate diverter and the pivoting chute diverter feature a removable access door, which allows access for inspection and maintenance while the diverter remains in-line. The aggregate diverter's entire bucket, and the pivoting chute diverter's inlet chute and pivoting chute, can all be removed and replaced though the removable access door (see Figure 6), allowing for quick repairs without lengthy downtime.

Abrasion-resistant liners

Unlike typical diverter designs, Vortex diverters can incorporate abrasion-

Figure 7: a rock box can be fitted to the Vortex aggregate diverter at the inlet, on the blade and along the outlet chutes

Figure 8: abrasion-resistant liners ensure that materials abrade upon highly-durable, replaceable parts rather than abrading upon the diverter itself

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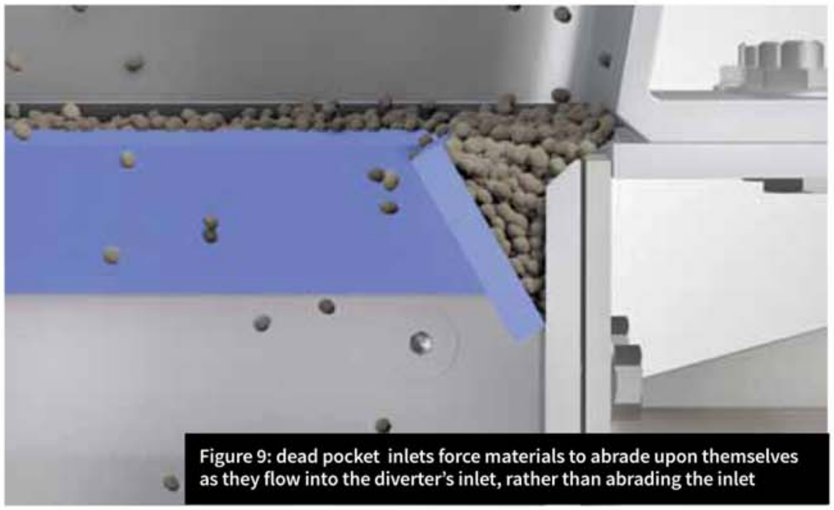

Figure 9: dead pocket inlets force materials to abrade upon themselves as they flow into the diverter's inlet, rather than abrading the inlet

resistant features. A vortex aggregate diverter can be equipped with an internal rock box at the inlet, on the blade, and along the outlet chutes (see Figure 7). The rock box design allows material to accumulate in gridded areas so that as the material flows, it abrades upon itself, rather than upon the diverter's internal mechanisms. It should be noted that rock box designs should only be considered if cross-contamination is not a concern.

Alternatively, Vortex diverters can use replaceable AR liners (see Figure 8). Wear liners can be constructed from highly-durable metals, such as 400 BHN carbon steel, chromium carbide or titanium. For cost-benefit purposes, wear liners are critical because they ensure materials abrade upon replaceable parts, rather than needing to replace an entire diverter because materials have abraded a hole in the diverter body.

Dead pocket inlet

At the inlet both the aggregate diverter and the pivoting chute diverter can be equipped to feature a dead pocket (see Figure 9). By incorporating a dead pocket inlet, small amounts of abrasive materials are trapped along the sides of the inlet. As additional materials flow, the dead pocket inlet forces materials to abrade upon themselves, rather than abrading through the inlet.

Again, dead pocket inlets should only be considered if cross-contamination is not an issue.

Abrasion resistance using a K-style (straight leg) design

A diverter can offer additional abrasion resistance by using a K-style diverting design versus an A-style design (see Figure 10). Also known as a straight leg design, the K-style diverting option is frequently used in applications where material is being diverted toward one destination (the straight leg) more often than the off-leg.

In abrasive applications, K-style diverting is preferred because it allows a straight-through channel, which lessens wear to a diverter's internal mechanisms and means that the outlet legs do not meet in the direct path of travel as materials flow through the inlet.

Steep outlet angles to avoid wear and abrasion

When diverting abrasive materials in gravity flow, mechanical wear can be minimised by using steep angles at each of the diverter's outlet legs.

Raw materials used in cement production often have a high bulk density because of their hardness. If a diverter has more subtle outlet angles (approximately 45˚ from vertical), material velocity will slow, causing materials to drag along the bottom of the diverter as they flow through.

However, if a diverter has steeper, more dramatic outlet angles (approximately 30˚ from vertical), materials are able to suspend and flow freely through the channel. This allows for optimal flow rates for most materials used in cement production, and also reduces the likelihood of in-line material build-up or material plugs.

When materials are suspended, they make little contact with the diverter's internal mechanisms, thereby subjecting the diverter to less wear and abrasion.

Heavy-duty construction materials

When handling abrasive materials used in cement production, Vortex slide gates and diverters can be equipped with added durability by constructing the body, blade and material contact areas from abrasion-resistant metals. For most heavy-duty applications, the body, blade and material contact areas are constructed from 400 BHN abrasion-resistant carbon steel. For more extreme applications, these areas can be constructed from chromium carbide or even titanium. Vortex's design philosophy is fuelled by the desire to make additional application-specific considerations - to be sure clients' processing needs are truly solved for the long-term. ■

Figure 10: while the intended uses of A-style (left) and K-style (right) diverters may be similar, the K-style diverter is often more suitable for use in abrasive applications