SEPTEMBER 2020

International Cement review

Company profile

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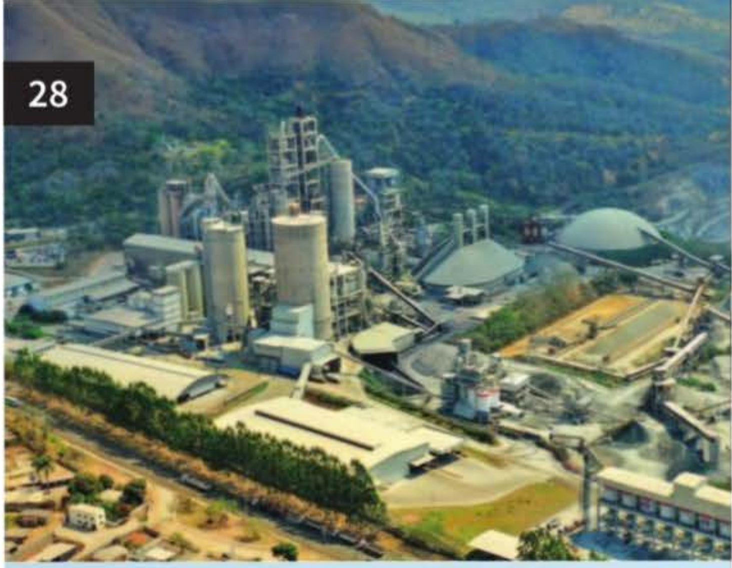
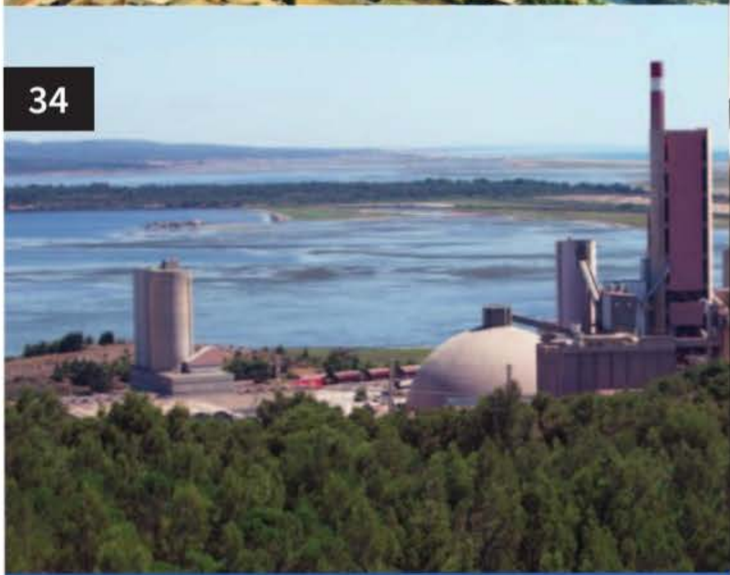
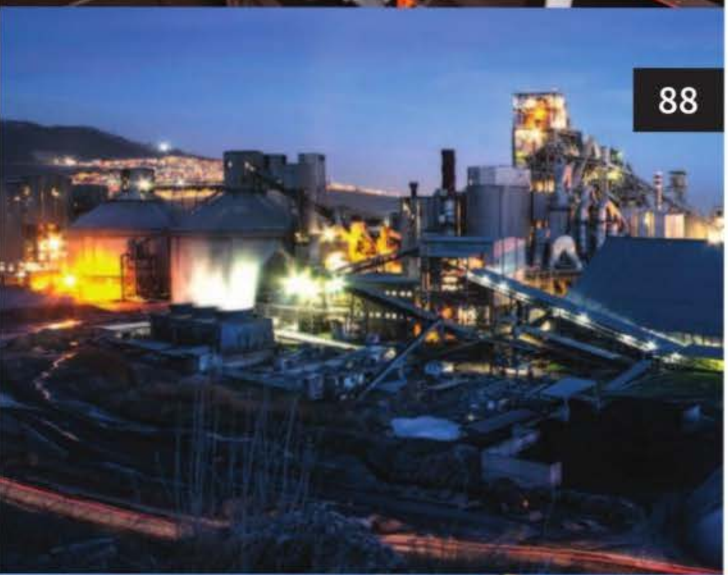






Preview: ICR October 2020 issue

Oktoberfest will be silent this year, but ICR is still supping on the flavour of Germany's cement industry, which continues to advance emissions reduction and alternative fuel substitution rates.

Meanwhile, Chip Mong INSEE cement explains how it will target sustainability goals for 2022, including 10 per cent cut in CO_2 emissions.

West Africa's fast-track expansion

Coastal cement production comes to the fore as Limak Cement opens its doors on the cement market in Côte d'Ivoire, where it has constructed a 1Mta grinding plant in Abidjan.

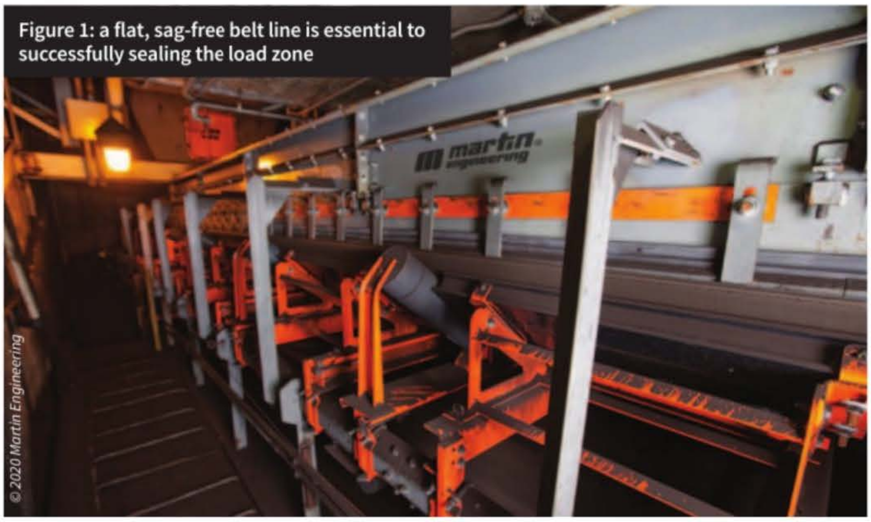
Conveyor belt support

For a conveyor to control dust and spillage, the design engineer must do whatever is practical to keep the belt's line of travel consistently steady and straight. While there are many factors that influence the belt's running line both inside and outside the loading zone, a key ingredient is proper belt support.

■ *by **Daniel Marshall**, Martin Engineering, USA*

Modern belt support systems are designed to retain a smooth belt path with minimal bumping or disruption of settled cargo, avoiding gaps in the loading zone and minimising belt sag along the length of the system. New designs reduce maintenance costs and improve safety by offering easier access to components and decreasing the amount of labour required to perform routine maintenance.

Figure 1: a flat, sag-free belt line is essential to successfully sealing the load zone



Building proper belt support

Before any support components (cradles, idlers etc) are installed, the structure on which all conveyor equipment is attached (ie, the 'stringer') must be precisely aligned and the footings secure. Stringer alignment using laser surveying is the preferred method. Appendix D of 'Conveyor Installation Standards for Belt Conveyors Handling Bulk Materials' by the Conveyor Equipment Manufacturers Association (CEMA) provides installation tolerances. It is also imperative that footings provide rigid support to prevent movement or deflection. Finally, engineers should account for the amount of material being loaded and the force of the impact to prevent excessive belt deflection under the load.

As noted in the Foundations™ industry reference book by Martin Engineering, the belt's line of travel must be stabilised with proper support in the loading zone to achieve an effective, minimum-spillage conveyor.[1] Ideally, the belting should be kept flat, as if it were running over a table that prevented movement in any direction except in the direction the cargo needed to travel. With a true belt line, support components can better maintain a sealed environment. According to CEMA, there are a number of techniques and components that can be used, independently or in combination, to control belt sag by improving belt support in the loading zone. They include idlers, belt support cradles and impact cradles.[2]

Belt sag: millimeters away from downtime

Belt sag, when viewed from the side of the transfer point, is the vertical deflection of the belt from a straight line as drawn across the top of the two adjacent idlers (see Figure 2).

Serious belt damage occurs when abrasive spillage wedges into high-pressure entrapment points between the belt and skirtboard. This causes a long gouge down the entire length of the belt and damages the sealing system and other components, worsening the spillage problem (see Figure 3). Even a millimeter

Figure 2: belt sag is a vertical deflection from a straight line across the top of two adjacent idlers

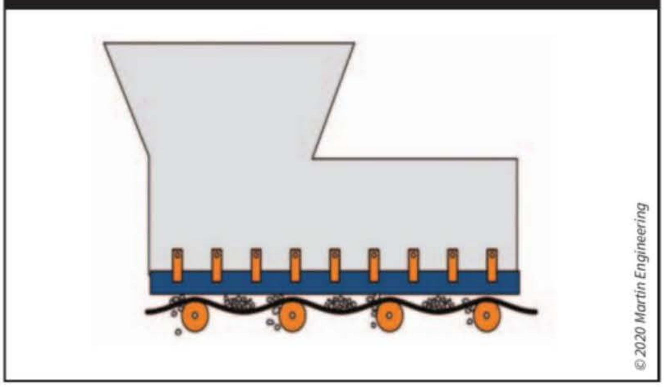


Figure 3: a groove in the belt cover can usually be attributed to entrapped material

Table 1: idler classifications based on CEMA standards

CEMA idler classification	Roll diameter		Belt width		Description
	(mm)	(in)	(mm)	(in)	
B4	102	4	450-1200	18-48	Light duty
B5	127	5	450-1200	18-48	
C4	102	4	450-1200	18-60	Medium duty
C5	127	5	450-1200	18-60	
C6	152	6	600-1500	24-60	
D5	127	5	600-1500	24-72	
D6	152	6	600-1500	24-72	
E6	152	6	900-2400	36-96	Heavy duty
E7	178	7	900-2400	36-96	
F6	152	6	1500-2400	60-96	
F7	178	7	1500-2400	60-96	
F8	203	8	1500-2400	60-96	

Metric dimensions are conversions by Martin Engineering. Belt widths may not be actual metric belt sizes.

of sag is enough to permit fines to become entrapped, leading to abrasive wear.

Spillage and dust can be a workplace safety compliance issue but may also significantly raise the cost of operation. Cleaning around and under the system can potentially put workers in dangerous proximity to a moving conveyor. Moreover, abrasive spillage and dust can foul bearings, causing them to seize. The result is typically high-temperature friction and belt damage, requiring unscheduled downtime to fix.

Idlers

Idlers are the most numerous of conveyor components, in terms of both the number used on a particular conveyor and the number of styles and choices available. There are many types, but they all share the same responsibilities: to shape and support the belt and cargo, while minimising the power needed to transport the materials.

Idlers are generally classified according to roller diameter, type of service, operating condition, belt load and belt speed. They are rated on their load-carrying capacity and calculated bearing life. CEMA uses a two-character code that expresses the idler classification and implied load rating, with a letter-based code followed by idler diameter in inches, resulting in classes from B4 to F8 (see Table 1).

Available in flat or troughed designs, carrying idlers provide support for the loaded belt. The flat idler usually consists of a single horizontal roll for use on flat belts, such as feeders. The troughed idler typically consists of three rolls – one horizontal roll in the centre with inclined (or wing) rolls on either side (see Figure 4). The angle of the two inclined rollers from horizontal is called the trough angle. These are designed to support and shape the belt into a specific trough angle for the conveyance of cargo.

One solution for absorbing impact in the belt's loading zone is cushioned impact idlers, which typically have a similar load rating to standard idlers, with the same shafts and bearings. One disadvantage is that each idler supports the belt only at the top of the roller. No matter how closely spaced, the rounded shape and deflective rubber will allow the belt to oscillate or sag away slightly from the ideal flat profile (see Figure 5).

With long centre rollers and smaller side rollers, the picking idler delivers a shallow trough with a wide base, giving larger cargo such as raw stone a wider area on which to settle. Without that wide base, large chunks would drift to one side of the belt or the other, which can cause misalignment (see Figure 6).

Most of these designs are in-line idlers, meaning all three rollers are positioned end to end. Offset idlers place the centre roller slightly in front of the wing rollers, which are aligned in a V slightly below the centre roll profile. By reducing the overall height of the idler set, this configuration is excellent for cramped quarters such as mines or other applications that require heavy-duty support but lack the space (see Figure 7).

Idler spacing and power consumption

The spacing between idlers has a dramatic effect on the support and load shaping they can provide. Idlers placed too far apart will neither properly support the belt nor enable it to maintain the desired profile. Placing them too close together increases the cost of equipment and conveyor construction, as well as power consumption.

Typically, idlers are placed close enough together to support a fully-loaded belt so it will not sag excessively between them. Sagging causes the load to shift as it is carried up and over each idler and down into the valley between, increasing

Figure 4: troughed idlers typically have a horizontal roller with an inclined roller on each side

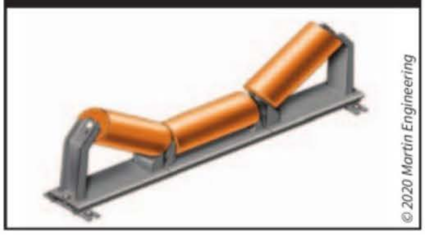


Figure 5: impact idlers

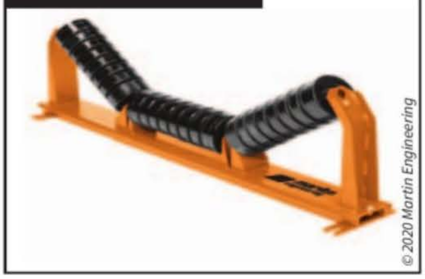


Figure 6: picking idlers provide a low through angle to help centre large chuncks of cargo

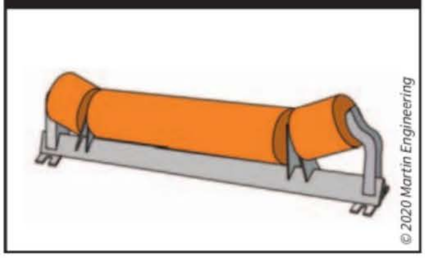


Figure 7: offset idlers can reduce the overall height of the assembly

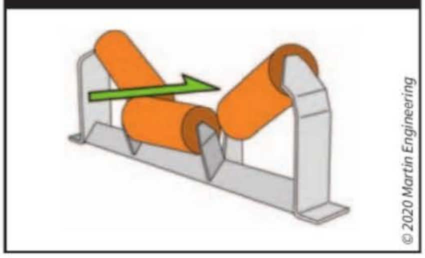
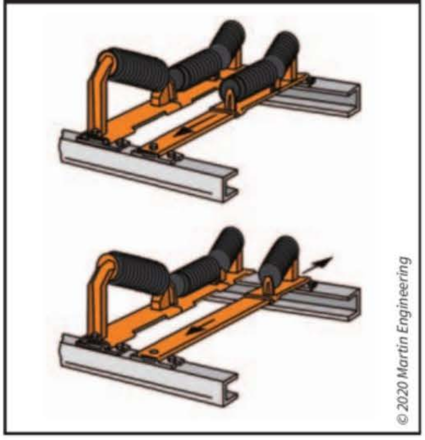


Figure 8: track-mounted idlers can be serviced more quickly and safely than standard designs



belt wear and power consumption while contributing to fugitive dust and spillage. This complicated mathematical relationship has been published. CEMA has produced tables of recommended idler spacing for applications outside the loading zone.

Idler maintenance

When idlers seize or sustain damage, the unprotected underside of the belt can be damaged. Extreme temperatures from the friction may cause combustible cargo or the belt to ignite, carrying the fire the entire length of the belt within seconds.

For obvious safety reasons, maintenance needs to be performed on an empty and clamped belt during downtime using the proper lock-out/tag-out/block-out/test-out procedures. In the past, an idler set could be difficult to access and change, often requiring the worker to reach in past the belt plane.

To address this issue, track-mounted idlers are designed with three rollers mounted as an in-line set on the same track assembly, engineered to be easily extracted in separate sections for maintenance outside of the conveyor plane. This enables easier and faster maintenance in a safe environment, reducing the amount of labour and downtime required to perform the procedure (see Figure 8).

Support cradles and power consumption

The 'flat table' concept is so important to good sealing that many designers now use cradles in place of idlers under conveyor loading zones. Instead of using an idler's rolling 'cans', cradles use low-friction bars to support the belt profile.

Belt support cradles perform two functions – controlling belt sag in the load zone to curtail spillage and providing a slick surface upon which the belt can ride. In addition, impact cradles reduce belt damage by absorbing the forces from the landing of material on the belt. Other benefits of using cradles under the transfer point include a reduction in moving parts and elimination of required lubrication. The modular design of the typical cradle system allows the belt support to be extended as far as the circumstances require.

Figure 9: impact cradles minimise belt damage and improve edge sealing

Impact cradles in the loading zone

Some bulk handling operations drop material from a great height through a long chute with nothing to control the descent. Constant high magnitude impacts without proper support can damage the belt cover and weaken its carcass. An example would be an 18in (45.7cm) lump of sandstone dropping 7ft (2.13m). This lump will hit the belt with the same energy as a fully-loaded refrigerator falling 10ft (3.05m). Bulk material can also 'splash', sending debris in all directions at a high trajectory and creating a 'ripple' effect on the belt, de-stabilising its line of travel and increasing spillage.

To minimise these negative effects, impact cradles are installed directly under the material drop zone to bear the brunt of the shock of the material hitting the belt as it loads (see Figure 9). These cradles are usually constructed of a set of individual impact-absorbing bars assembled into a steel support framework. The bars are made from durable elastomeric materials that combine a slick top surface – allowing the belt to skim over it to minimise friction – and one or more sponge-like secondary layers to absorb the energy of impact.

A number of 'combination cradle' designs are available, which use bars for a continuous seal at the belt edge but also incorporate rollers under the centre of the belt (see Figure 10). These hybrid designs are popular as a way of combining the low power consumption of rollers with the flat sealing surface of impact or slider bars. The running friction is kept low by supporting the centre of the belt with conventional rollers, reducing power consumption. The belt edge is continuously supported, eliminating belt sag between the idlers. Some models allow the bumpers to be flipped to double the service life.

Figure 10: a "combination cradle" uses bars for sealing the belt edge and rollers to support the centre

Cradle maintenance

Some cradles are fixed to the crossbeam and require workers to reach in or access the units from underneath. However, if there is available room in the work area, there are units engineered to slide away from the stringer during scheduled downtime when the belt is empty.

Much like pulling out a drawer to a filing cabinet, a single worker removes the locking pin in a one-tool procedure and simply slides the cradle into the open-access area to perform maintenance outside of the belt plane. This creates a safer work environment, improves access for higher quality maintenance, reduces the amount of labour needed and minimises the amount of downtime required for the procedure.

Maintenance procedures for a conveyor belt-support system should include regular inspection and reporting either by a designated internal resource or a maintenance contractor, including:

Case study: GCC Dakotah, USA

Like most cement manufacturing sites, the GCC Dakotah plant in Rapid City, South Dakota, USA, employs an extensive conveyor system to handle raw materials and move finished product. In keeping with its long-range plans to employ industry best practices for bulk handling and fugitive material control in its plants, company officials conducted an extensive assessment of the conveyors and determined that significant upgrades could be made on conveyor transfer points to reduce spillage and dust emissions.

The upgrade involved a significant overhaul of six transfer points on four conveyors, which were originally constructed in the late 1970s. All belts are 24in (61cm) wide and range in length from 40ft (12.2m) to 110ft (33.5m). During normal operation, they move 200-250tph of clinker from the storage building and carry it to the bins feeding the finish mills. In addition to supplying the components, Martin Engineering was responsible for planning and supervision of the project, while a mechanical contracting group assisted with the installation.

Work began on all four conveyors by disconnecting the material inlet chutes from the existing skirtboard system and removing the worn rubber skirt seals, clamps, supports, skirtboard chute walls and tail boxes. Existing idlers were also removed to allow mounting of new belt support systems and troughing roll assemblies.

On each conveyor, three track-mounted idlers were installed and spaced to deliver optimum belt support. The unique idler design delivers proper belt carriage, while stabilising the belt line to improve sealing. With new idlers and troughing roll assemblies in place, each transfer point received one new impact cradle and two belt support cradles. Installed under the loading zone, impact cradles absorb the force of falling material in a transfer point and stabilise the belt line to help prevent the escape of dust and fines.

Working in conjunction with the impact cradles are a pair of Martin® Slider Cradles on each conveyor. Installed under the skirtboard of the transfer point, these cradles support the edges of the belt specifically to eliminate sagging. With the proper support in place, pinch points that can trap material and gouge the belts are eliminated, improving both sealing efficiency and belt life. When the top eventually wears out, the bars can simply be flipped over to provide a second wear surface.

The entire upgrade operation was completed in just 11 days during the scheduled outage, with crews working 12h days to accommodate the planned shutdown. While specific cost savings are difficult to quantify, Ralph Denoski, GCC maintenance manager, said the difference is easily observed. "The production team responsible for that area has had nothing but positive feedback about the upgrades," he commented.

"We're not losing product to spillage and dust, so that material can be sold instead of cleaned up off the floor. The manpower formerly spent on cleanup can now be directed to core business activities."

Each transfer point received one new impact cradle and two belt support cradles

• identification of areas with excessive spillage and determine the cause
• inspection of rolling components for wear and operation
• scheduled replacement of seized, damaged or worn rollers
• lubrication of bearings in rolling components as appropriate
• inspection of belt-support cradles
• adjustment of cradles to compensate for wear
• realignment and/or replacement of bars showing abuse or wear
• removal of material accumulations from rollers, frames, cradle structure and support bars as required
• default to the manufacturer's instructions for the required maintenance on any specific component.

Experienced system designers recommend selecting belt support system components that prioritise ease of maintenance. The easier maintenance is to perform, the more often it will be carried out, resulting in longer equipment life, reduced downtime and lower cost of operation.

Conclusion

The use of improved belt support and sealing techniques places additional requirements on conveyor drive systems. However, these additional requirements and costs will seem minor when compared to the power consumed by operating with a single 'frozen' idler, or several idlers operating with material accumulation. By implementing the proper belt support systems, a plant can prevent the many costly problems that arise from the escape of fugitive material. It is better to design a system that incorporates the slightly-elevated power consumption required to prevent spillage, rather than suffer the much higher power consumption and greater consequences that arise from fugitive material. The costs for installation and operation of proper belt support systems represent an investment in efficiency. ■

REFERENCES

[1] SWINDERMAN, RT, MARTI, AD, GOLDBECK, LJ, MARSHALL, D AND STREBEL, MG (2009) 'Chapter 10: Belt Support' in: *Martin Engineering: Foundations™, 4th Edition*, p130-151.

[2] CONVEYOR EQUIPMENT MANUFACTURERS ASSOCIATION (CEMA) (2005) 'Appendix D: Conveyor Installation Standards for Belt Conveyors Handling Bulk Materials' in: *Belt Conveyors for Bulk Materials, Sixth Edition*, Naples (FL), USA, p575–587.