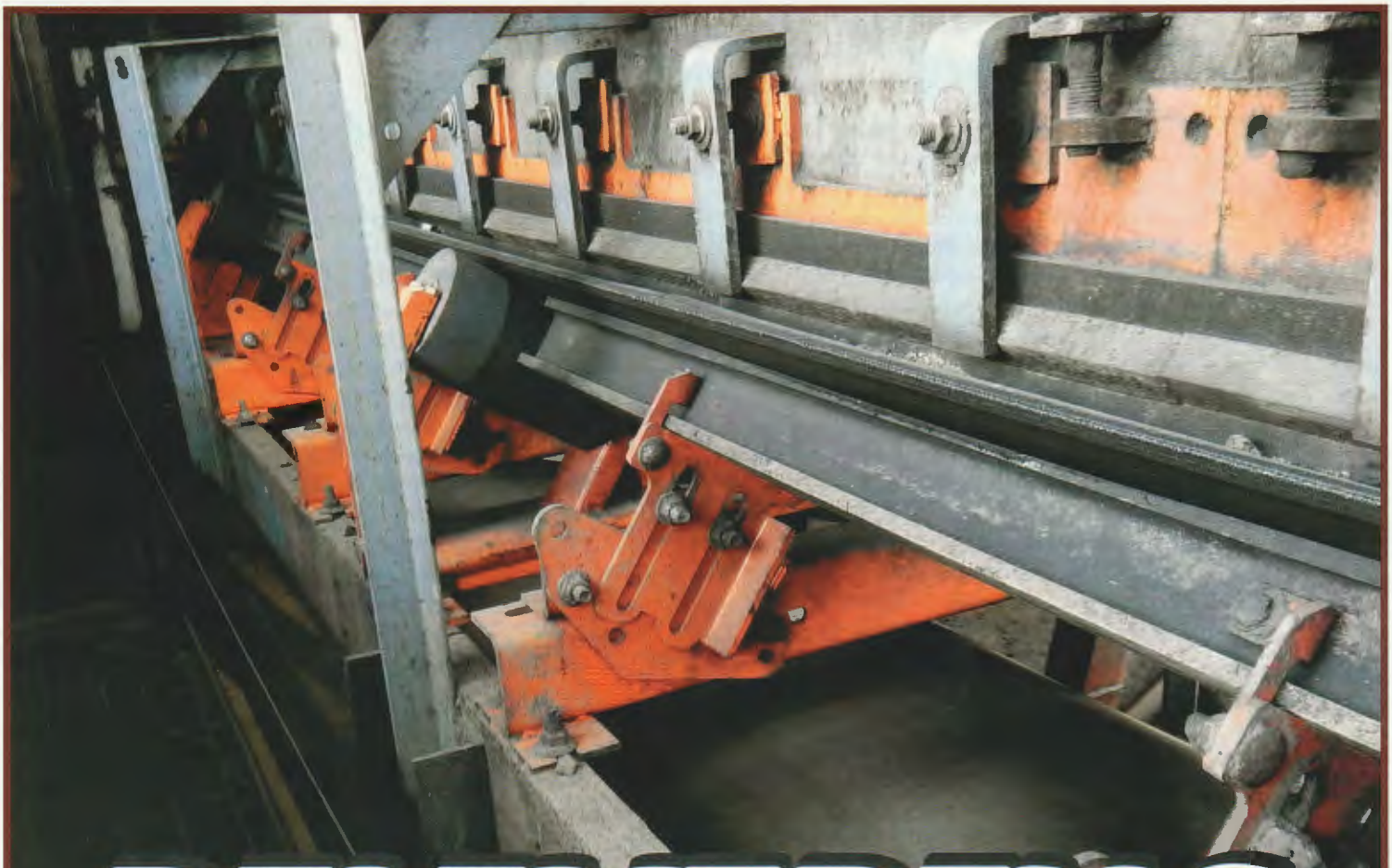

DELIVERING RESULTS

CORY GOLDBECK, MARTIN ENGINEERING, USA, DETAILS KEY UPGRADES MADE TO CONVEYORS AT A FERTILIZER PLANT, WHICH IMPROVED EFFICIENCY, CONTAINMENT AND SAFETY.

The Coffeyville Resources nitrogen fertilizer plant in Coffeyville, Kansas, US, is one of just two such plants in North America that does not rely on natural gas as an energy source. It is the only plant that uses petcoke gasification to produce hydrogen – a key ingredient in the manufacturing process. The facility is located next to a refinery, enabling it to take advantage of the large volumes of petcoke from the refining operation and use the coke as fuel to manufacture ammonia and urea ammonium nitrate (UAN) fertilizers. A wholly-owned subsidiary of CVR Partners LP, the facility produced 388 900 short t of ammonia and 963 700 short t of UAN in 2014 – enough to supply approximately 5% of the total demand in the US. About 80% of the petcoke required for production came from the neighbouring refinery.

Historically, petcoke has been significantly less expensive than natural gas on a per-tonne-of-fertilizer-produced basis. Petcoke prices have also been more stable when compared to those of natural gas. By using petcoke as the primary energy source instead of natural gas, CVR Partners' nitrogen fertilizer business has traditionally been the lowest-cost producer and marketer of ammonia and UAN fertilizers in North America.

The Coffeyville operation moves most of the petcoke via conveyor, with the plant maintaining completely redundant systems to protect against unplanned shutdowns.

"The dual conveyor systems have run for many years without major failures, but they were beginning to show their age," commented Operations Technical Superintendent Marc Gilbertson. "There have also been a number of advancements in conveyor technology since that system was installed and we wanted to leverage the latest component designs to improve material control and overall efficiency."

One of the primary issues Gilbertson wanted to address was material containment: reducing the amount of dust and

spillage that escaped from the conveyors. He met with representatives from Martin Engineering and together they walked the entire length of two sets of twin conveyors, identifying problem areas and potential solutions. The team identified conveyors 19A and 19B as being most in need of attention, each with a 24 in. wide belt and 300 ft long. Travelling at 400 ft/min. (~2 m/sec.), the belts carry an estimated 1400 tpd (3080 kg) of petcoke to an entrained flow gasifier. The twin belts have two load zones each, which were among the main points of concern.

"The spillage was significant," Gilbertson explained. "We were seeing waist-deep piles accumulating each day, which required an average of about 90 man-hours per week to safely clean the affected areas and haul the material away." In addition, Gilbertson estimated that the operation invested another 16 hrs of maintenance time each week to clean and adjust the belts, address worn components and keep the system running. "We were wearing out belts, rollers and other components prematurely," he said. "Between the replacement parts and the combined labour, we felt there was a good opportunity for cost reductions."

The Martin Engineering team began by providing Gilbertson and his staff with some education on new designs for handling bulk material, including load zone components and transfer points. "Based on our site visits, we determined that the containment issues were primarily a result of carryback from insufficient belt cleaning and misalignment," observed Martin Engineering Territory Manager, Mike Long. "The skirts and tail boxes were also allowing fugitive material to escape."

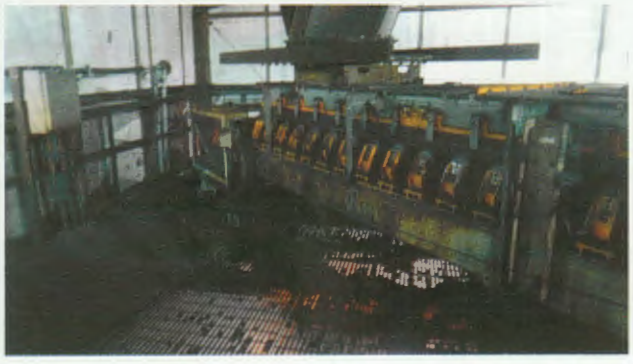

Figure 1. Before the upgrade, fugitive material required about 90 man-hours per week to safely clean and haul away.

Figure 2. The twin belts have two load zones each, which were among the main points of concern.

Stabilising and sealing

The company's proposal included upgrading the transfer points to eliminate belt sag, provide effective sealing and improve belt cleaning, as well as alignment systems to deliver continuous adjustment and maintain a consistent belt path. The Martin Engineering team recommended components specifically designed for durability under the heavy load and impact at the transfer points.

Technicians first installed three impact cradles on both 19A and 19B, located under the belt in the loading zones. The cradle design features a bed of steel angles lined by energy-absorbing impact bars with a top layer of low-friction, ultra-high molecular weight (UHMW) plastic.

"Without proper impact absorption and distribution, all of the force is exerted on the belt, essentially crushing it against a rigid surface underneath," said Long. "Instead, the impact beds absorb the energy, so the belt doesn't have to. It also creates a flat edge for the edge seal, to prevent spillage and fugitive dust". Martin Impact Cradles feature wing supports, which adjust to match CEMA standard trough angles, as well as a 5% fine-tuning adjustment. This allows the cradle to accommodate the idler profiles of different manufacturers and assure a tight belt seal.

After the impact zone, a series of 16 slider cradles were installed on each conveyor to stabilise the belt line and eliminate bounce. Transfer points can be prone to spillage as the load lands on the receiving conveyor. Once the belt leaves the impact cradle, it can also sag as the material is still settling. This compromises the skirt seal, allowing dust and fines to escape, while creating entrapment points where material can get caught and gouge the belt.

Martin Engineering slider cradles are designed for conveyor systems with speeds up to 700 ft/min. (3.5 m/sec.) and belt lengths of more than 50 ft (15.2 m). Typically 48 in. (1220 mm) long, the units are also available in custom sizes for special applications. The proprietary box design allows each bar to be flipped over at the end of its useful life to provide a second wear surface. The result is a flat and stable belt surface throughout the settling zone, reducing fugitive material and extending belt life.

Following the cradles, 20 Trac-Mount™ idlers were installed on each conveyor. These rugged idlers have sliding frames on a stationary base that fits in tight spaces between belt support cradles for easy installation and service. Supplied with either steel or impact rollers, they require only 8 in. (203 mm) of space for the 6 in. (152 mm) rollers and can be serviced without raising the belt or removing adjacent rollers.

Dust management

The system upgrade also included 90 ft of modular chute wall, which provides a system of compatible components to build a transfer chute and wall structure. The pre-fabricated components make it easy to design and install transfer point

skirtboards and stilling zones to manage air flow and control dust, keeping climatic conditions outside and airborne dust inside. The components simply bolt together to reduce installation labour, requiring no field engineering or material waste, providing a precise fit to suit the specific requirements of each conveyor load zone.

To further improve containment, the Martin technicians also installed 184 ft of the company's ApronSeal™ skirting system, which provides dual-seal efficiency with a single, one-piece sealing strip for any trough angle to prevent the escape of fines and dust. This design delivers two wear surfaces on a single elastomer sealing strip. When the bottom side of the strip against the belt is worn, the sealing strip is inverted, providing a second service life.

It is the first dual-sealing system for belt conveyors, incorporating a primary seal clamped to the steel skirtboard to keep lumps on the belt and a secondary or 'outrigger' strip to capture any fines or dust particles that pass beneath the primary seal. The secondary seal lies gently on the belt and self-adjusts to maintain consistent strip-to-belt pressure, despite high-speed material movement and fluctuations in the belt's line of travel. The skirting floats on the belt and self-adjusts to maintain an effective seal without maintenance.

Tracking

The mis-tracking belt issue was addressed with a tracking system to deliver immediate, precise adjustment of wandering belts. Using multiple-pivot, torque-multiplying technology, the tracker detects slight misalignments initiated by unbalanced loads and fouled rollers, using the force of the belt to immediately adjust its position and realign the path.

Rollers attached to the end of a sensing arm assembly ride both sides of the belt edge, detecting even slight variations in the belt path. Employing the force of the wandering belt, the arms automatically position a steering idler in the opposite direction of the misalignment. Transferring the motion to the steering idler through a parallel linkage requires less force to initiate the correction, so fine-tuning of the path can be continuous, active and accurate. The tracker keeps the belt in alignment with automatic corrections to reduce edge damage, prevent spillage and maintain belt health.

Carryback

Carryback can be a vexing problem for conveyor operators – especially when loads are heavy and materials contain moisture, which tends to cause fines to stick to the belt and get carried along the return run, where vibration knocks the particles loose and deposits them on support structures, rollers and floors. To address this issue, technicians installed a dual cleaning system on the 19A and 19B conveyors. The primary unit is the company's QC1 Cleaner HD, a heavy-duty design with a one-piece curved urethane blade that delivers high-quality performance and features simple, one-pin replacement without tools to minimise service time when the blade wears out.

Engineered for head pulley diameters from 12 – 24 in. (~305 – 600 mm), the QC1 HD is suited for belts from 18 – 96 in. wide (~400 – 2400 mm) and speeds up to 900 ft/min (4.6 m/sec.). It can withstand corrosive conditions and service temperatures up to 180°F (82.2°C). The unit's patented constant angle radial pressure (CARP) design maintains cleaning performance through all stages of blade life; and the rugged 3/8 in. (95 mm) steel tubing main frame has a steel bar backbone, with an aluminium extrusion in the base to hold the cleaner snugly in place.

Mounted directly after the primary cleaner is a secondary scraper, the SQC2S™ cleaner, featuring individually cushioned tungsten carbide blades for effective cleaning without risk to the belt or splices. Patented rubber buffers maintain the cleaning pressure throughout blade life, while deflecting sufficiently to allow splices to pass without harm and ensuring compatibility with reversing belts or those that experience backup at shutdown. Moving parts are zinc plated to resist seizing or rusting.

"The blade segments conform to the belt profile, adjusting individually to deliver continuous contact across the belt," explained Long. "In a perfect world, bulk materials would load uniformly and wear the blade evenly, but that rarely happens. By having multiple segments attached to a single rigid assembly, the tension can be maintained and adjusted accurately, quickly and safely." Similar to the QC1, blade removal and replacement is a simple operation on the SQC2S by removing the lock pin from the main assembly and sliding out the cartridge. The lock pins are a key component to Martin Engineering's 'no-reach design', which allows workers to conduct their lockout/tag-out procedure more safely.

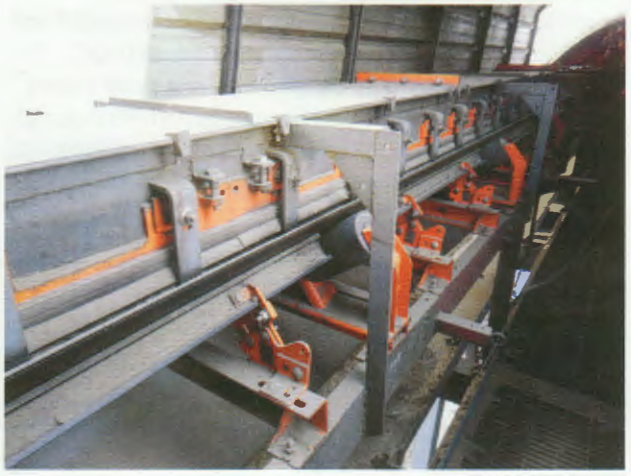

Figure 3. The project included upgraded transfer points to eliminate belt sag and improve sealing, as well as belt cleaning and alignment systems.

Figure 4. Technicians installed three impact cradles in the loading zones on each conveyor to create a flat edge for improved containment.

The two-conveyor project took about a week for each belt, with six Martin Engineering installers on site. The team completed one upgrade while the other conveyor continued running, then switched over to the second structure.

Results

Plant officials are extremely pleased with the outcome, which has drastically reduced the amount of dust and spillage, and, with it, the unproductive labour time to deal with the consequences. Gilbertson estimated that the total maintenance time to manage fugitive material on both conveyors is now down to about 8 hr/week, with belts and other components showing no signs of premature wear. Given the cost of labour alone, the company is thought to be saving more than US$14 000 each month. Longer service life from belts and components are expected to further increase their benefits. Moreover, company personnel spend less time working in close proximity to the moving conveyor, reducing potential risk, and the manpower savings are applied to more productive activities.

The Coffeyville plant management was so pleased with the results that they requested a second proposal upon completion of Conveyors 19A and 19B. This time it was for a similar upgrade to a shorter pair of conveyors: numbers 107A and 107B. These two 15 ft feeder conveyors supply material to the recently-upgraded systems. Both are 42 in. wide, running at 65 ft/min. The issues were similar to the #19 conveyors, and Martin technicians installed chute wall, idlers and skirt seals to contain dust and fines. To accompany the QC1 Cleaner HD on these systems, technicians installed a Martin Durt Hawg® DH2 secondary belt cleaner, which had a durable design with steel-tipped blades for demanding conditions. As part of the settling zone modification, they also installed EVO® external wear liner along the edges of the chute wall.

Unlike traditional wear liners, this design is mounted and serviced outside the chute wall, making it easy to inspect and replace without confined space entry.

"We're very happy with the results," Gilbertson concluded. "We've invested in the latest technologies to run more efficiently and do a better job of controlling fugitive material. The installation process was smooth and professional, and what used to be a huge maintenance task is now just occasional sweeping." The Coffeyville facility is already considering proposals to upgrade additional conveyors, as well as future training and service agreements. **WF**