Controlling dust

Phil Wowak and Aaron Gibbs, ASGCO Manufacturing Inc., US, explain how conveyors and transfer points can help to control dust in materials handling operations.

One of the big challenges to the safe conveying of coal, especially sub-bituminous coal such as that from the Powder River Basin (PRB), is dealing with the fuel’s high concentration of fine dust. The presence of this dust, combined with PRB coal’s high moisture content (20 – 30%), raises the risk of spontaneous combustion. Properly designed, maintained and operated conveyor belt systems play a major role in the safe handling of PRB coal.

Particular attention must be paid to cleaning because the buildup of dust can and along conveyors and transfer points poses safety problems. However, even fanatical cleaning is no substitute for a well-designed and operated coal conveying system.

There are three major areas of concern to minimise dusting and spillage on a typical conveyor:

- Load zone transfer points.
- Discharge point belt cleaners.
- Belt tracking.
Load zone transfer points
Transfer points are most often the major cause of dusting and spillage in and around conveyors. To tackle this problem, it is often necessary to modify the existing loading chutes, replace and upgrade existing transfer point chutes and skirting systems, replace and upgrade existing belt support systems, and seal up head chutes as needed to reduce induced airflow. The objective is to maintain existing material flow, while minimising load zone material spillage. To optimise the design of the chutes and transfer points, 3-DEM (discrete element modelling) software is used to create a 3-D wireframe representation of existing chute conditions. After this, the 3-D simulation is verified against observed plant conditions and modified to improve the flow of coal. The wireframe model is then converted to fabrication drawings. The same process is used to produce drawings for the skirt enclosures, tail box and belt support systems. The goal in this process is that the new conveyor transfer points will contain coal dust by reducing air movement within enclosures, eliminating spillage and minimising coal carryback. By centring the loads on the existing belts operating near their design speed, the modern chute design will also help to reduce wear and tear on the belts and chute components.

Case study
A coal-fired power plant turning PRB coal had a serious dusting problem at a primary transfer point. The 72 in. (183 cm) conveyors were handling 3600 tph at 650 ft/minute (198 m/minute). The existing chute design caused extensive dusting and internal liner wear, as well as material spillage and receiving conveyor belt wear.

The existing chute was modelled using ASGCO’s 3-DEM chute analysis software to determine and examine the design problems (Figure 1). A new chute configuration was then designed and analysed using the same program (Figure 2). The load zone on the receiving conveyor was also redesigned to include a more effective belt support system, as well as a new skirting seal. The new design has reduced dusting and wear to minimal levels and has eliminated load zone spillage and off-centre loading (Figure 3).

Discharge point belt cleaners
Primary belt cleaners or pre-cleaners are an essential part of any conveyor system. Belt cleaners help remove bulk material product carryback and prevent it from falling off at various points of the conveyor along the return side of the belt, which can cause various housekeeping and conveyor belt maintenance problems. Secondary cleaners are installed after the point where the belt leaves the head (discharge) pulley and or anywhere on the return side of the belt where it can be cleaned and maintained effectively.

Carryback can lead to:
- Excessive buildup and wear on conveyor belt idlers and pulleys.
- Conveyor belt misalignment due to the artificial crown created by the carryback.
- Accumulation of material falling off conveyor belt idlers and structure to the ground or onto buildings, vehicles or people.
- Unsafe work environment.
- Secondary cleaners installed after the point where the belt leaves the head (discharge) pulley and or anywhere on the return side of the belt where it can be cleaned and maintained effectively.

The guidelines for choosing effective belt cleaners should be:
- Design for optimum clean with the least amount of pressure.
- Position the blade out of the main flow of the material.
- If possible, install the belt cleaners in the main chute or an area that will be easily cleaned and maintained.
- Primary blades should be no more than the width of the material being converted.
- Engineered and designed to handle “worse case” conditions.
- Quick and simple replacement blade change.
- Tensioner to maintain tension throughout the life of the blade.

Figure 1. Original chute condition model, rendered using 3-DEM software.

Figure 2. Optimised chute model in 3-DEM.

Figure 3. Old (left) and new (right) load zone support system.
Conveyor washbox belt cleaning systems are also becoming widely popular in many coal mines and coal-fired power plants to stop the problem of fugitive dust from inadequate belt cleaner systems. A hold-down pressure roller opens the pours/cracks of the conveyor belt. This then allows the water sprays to loosen the carryback and constantly clean the carryback from the stainless steel tungsten carbide belt cleaners – all while being completely contained in a stainless tank system (Figure 4). Such systems have been the answer to many plant’s carryback and fugitive dust problems.

**Belt tracking**

Conveyor belt misalignment or run off can be a major cause of dusting and material spillage. When the belt is entering the load zone off-centre, the skirt seals can no longer effectively contain the coal on the belt and leakage will occur. Belt misalignment can be caused by several issues.

For a conveyor belt to run straight, it is essential that all idlers, pulleys, and loading conditions are properly adjusted to correct any areas of the belt run off.

The empty belt must trough well and contact the centre roll of all top-side carry idlers. For the belt to run straight, all pulleys and idlers must be at right angles to the conveyor centre line. An unloaded belt should be run only for as long as necessary to observe tracking and locate where to make adjustments for the belt to run straight.

When the entire belt runs off through a complete section of the conveyor, the problem is usually the result of misalignment or levelling of conveyor structures, idlers or pulleys in that section. If only one section of the belt runs off throughout the entire conveyor the problem is usually caused by the belt itself, most likely in the splice or a cambered section of the belt.

In a new installation, when adjustments have been made for the belt to run well, the belt should be fully loaded and the conveyor operated for at least a full production shift. It should also be stopped and allowed to stand idle overnight with a full load on it. This will help with the break-in time for adjusting the belt to flex in a troughed position. When training a new conveyor installation, efforts need to be concentrated on centring the belt on the head and tail pulleys. Adjustment on the head end snub pulley will help train the belt at the point where it enters the return run. Adjusting the return idlers will affect the travel position of the belt over the tail pulley end. The belt must track over the centre of the tail pulley in order to enter the load zone straight. This will prevent an off-centre loading condition, which can cause material spillage in the load zone.

If loading is off-centre, the belt will run off-centre up the entire length of the carrying side. These conditions are most easily remedied by properly redesigning the load zone. Self-aligning carry idlers will also help to track the belt back in line but are no substitute to a properly installed loading zone.

If all corrective measures have been taken to achieve belt alignment, and the belt still does not pass over the centre of the head or tail pulleys, alignment could be achieved by adding self-aligning training idlers in the belt section approaching the problem pulley. For best results, one training idler should be located at least three times the belt width but no more than 50 ft (15 m) from the pulley, and the other placed 100 – 200 ft (30 – 60 m) ahead of the first.

**Most effective self-aligning idlers**

The most effective type of training idler is one that is non-damaging to the belt and reacts immediately if the conveyor belt begins to drift off-centre. Many conventional designs incorporate a side roller or contact shoe to actuate the idler to pivot on an external axis. This external pivot is exposed to material build up and corrosion, which can cause the training action to be reduced or, in some cases, cause the belt to miss track if the pivot becomes inoperable.

The most effective type of return training idler does not rely on contact with the belt edge in order to guide it. This means that conveyor belt edge damage, which occurs frequently with other tracking systems, is avoided. An internal centre pivot manufactured using corrosion resistant stainless steel will prevent corrosion and will not be affected by fugitive material and carryback.

A rubber or urethane covering on the roller will increase the friction co-efficient and increase the training action and efficiency. This also prevents carryback material from building up on the roller.

The training idler also has special tapers (similar to a crown pulley) on the outer edges of the tracker that cause the drum of the idler to pivot about an internal, vertical pivot axis. The internal central pivot is perpendicular to the belt and this results in the tracking action always being on the same horizontal plane as the belt. Therefore, this style of training idler works equally well with reversible and shuttle conveyors (Figure 6).

The three areas discussed – load zone transfer points, discharge point belt cleaners and belt tracking – are the most important areas of a conveyor system to properly engineer, install and maintain in order to reduce fugitive coal dust in today’s coal mine, power plant or coal bulk shipping facility.