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Alternate Methods to Avoid Coal Spillage from Conveyors

***Abstract*—The spillages result from too much feed from the chute, concerning overflow as the material is initially deposited onto the conveyor, or material floating free of the conveyor as it is moved along it, or both, and also the Spillage occurs when fines and water accumulate on the inclined section of the conveyor and gain sufficient volume to form a stationary "teardrop" shape which cannot be transported by the belt up the incline.**

***Index Terms*—** Coal Spillage, Conveyors, Belts, Water accumulation, Chute design.

I. Introduction

Belt conveyors are frequently operated on an upward and downward incline. The angles of maximum inclination are recommended on the basis of wide previous experiences and vary for coal from 15° to 20°. The recommended angles are far below the actual values of the angles of friction between belt surface and the conveyed bulk solid. The angles recommendation

is rather conservative, and its procedure is lacking in well documented experimental results from a tribological investigations on the coefficient of static and kinetic friction between the specific bulk solid (e.g. coal with described essential characteristic – one coal is not kind of all coal) and the carrying surface (e.g. rubber belt with essential material and surface characteristics).

- Spillage can occur from violent loading, off-center loading, and belt mis-tracking. Violent loading can dilate skirt seals, forcing leakage. Violent loading on inclines may not settle and spill when leaving the skirt zone.
- Off-center loading heaps material to one side and it may not be contained once it leaves the skirt zone. Off-center loading causes lateral non-symmetrical thrust forces, which can push the incoming belt far enough off-center to cause spillage upon leaving the skirt zone.

CEMA, DIN 22101, and ISO 5048 specify that the belt capacity must include a free edge clearance. This clearance amounts to 6% of the belt width for each side of the wing rolls. The 6% figure is a long established value resulting from experience. Aside from belt slope, the figure accounts for a) load tracking error, b) lump containment, c) belt construction tracking error (rubber and steel), d) belt transition containment, and e) structural and idler alignment errors.

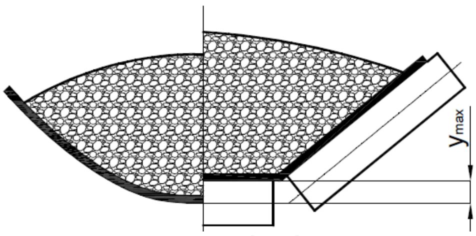

Figure 1: Free Edge Clearance

II. General Precautions to avoid Coal Spillage

Conveyor belting is somewhat porous. When excess water from rain or wash-down gets on a belt, the water molecules fill the pours on the belt and can freeze which reduces the coefficient of friction between the belt and the material being conveyed. If the material being conveyed will convey up the incline on the conveyor when it's dry, maintaining a dry belt when it rains should solve the problem. This can be accomplished by a squeegee/belt cleaner. If your material is wet, squeegee the belt dry prior to loading to remove as much water as possible. If material characteristics change, the material's inherent angle of inclination may decreases. Thus we may

-To resolve the problem, employ additional belt wipers at the head discharge and at the tail end to wipe the belts effectively.

-Second, work to control/reduce the feed rate during start-up and shut down. This provides a column/uniform flow rate of material onto the belt at the given belt speed (reducing the material bed depth or head pressure of wet material).

Weather protective conveyor covers are used to protect the material, conveyor belting and idlers from the elements. Covers also help to keep windblown rains and snow off of belts and protect the belting from sunlight. Ultra Violet light attacks conveyor belting and makes it brittle, causes belt cracking, reduced friction and premature belt life. To help prevent material sliding on wet or frost laden belts, squeegee the belt on the return run to remove excess moisture to increase the coefficient of friction between the belt and material. In cold weather climates, belt wipers and belt heaters that are activated during inclement weather on the return belt run, (just prior to material loading area) are beneficial. Belt heaters help to release the ice crystals from belts and the wipers wipe off the icing. Heaters can be interlocked with the belt speed indicators for safe operation. Anti-freeze agents/surfactants (glycol, grapefruit extract or other citric product are also known as quick remedies used as de-icers). If the belt is cleaned properly and is dry, wet material will STICK to it. If the belt is wet (pours are filled with water, wet and/or dry material or ice crystals), both wet and dry material may well slide over it. It is recommended that run the belts empty and let the wipers dry and clean the belts effectively before introducing material onto the belts.

Once dry; continue to wipe them during normal operation. Inspections should be made of the conveyor belting to ensure the top cover of the belt is not made slick by belt wipers and/or from the material being caked-onto the belting. Some belt wiper compounds fill the pours of the belt as they wear, making them "slicker". The same goes for some materials being conveyed. A change in wiper compound or a more aggressive wiper may be required. A uniform and consistent feed to prevent material from surge loading will prevent periodic material voids on the belts and minimize the possibility of material sliding. Avoid stopping and starting belts under load.

Feed the material onto the belt using an effective chute design to continually spoon feed the material at a velocity, near to that of the belt speed in the direction of the belt travel. Material may also migrate and try to nest on the conveyor belt as the belt shifts over idlers. If the belt is wet and the material won't convey up the incline, the belt may slide underneath the material until dried material pushes (head pressure) the sliding material back the incline. Consequently, a dry section of the belt may grip the wet material and work to bring the sliding material up to the belt speed. Until all the material is brought up to the belt speed, material spillage, sloughing, and sliding may occur. Belt lift-off of idlers, due to excessive belt tension in concave curves may also occur. If this is the case, the result is material rolling and varying PIW requirements within the belt."Increasing the coefficient of friction" between the belt surface and the material being conveyed is paramount. Effective belt wipers at the head discharge and a wiper near the tail that can be activated in foul weather is the immediate suggestions for Spillage issues."

Effective wipers will increase conveyor performance/up-time by reducing additional material carry-back, belt tracking from idler build-up, and potential belt damage and idler failure. However, as a precaution, please note that some of the more aggressive belt wipers have been known to cause premature belt damage from improper installation, maintenance and miss-use. On applications where the conveying incline or decline angle exceeds the material's natural angle of repose, alternate belting technology and system designs have proven effective.

III. Spillage leads to Coal charges

At present, the following track access charges are levied on freight operators carrying coal in United Kingdom and Some other Countries:

A. Coal Spillage Charge (CSC)

Designed to recover the cost impact of coal spillage on the network. For example, the cost of clean-up, delay minutes and reduced asset lives.

B. Coal Spillage Reduction Investment Charge (CSRIC)

Finances a fund that can be used to invest in equipment at coal terminals with the aim to reducing coal spillage on the network.

Studies have been going on to cope with such kind of spillages issues to minimize material waste and the time and money.

Figure 2: Coal Spillage from Conveyor

III. Alternate Methods to Reduce Coal Spillage from Conveyors

1. Double check belt incline, may be too steep. Check motor sizing, may be too small, causing gang up, slow down, build up, etc which would eventually overflow belt. Also check the actual troughing idler angle (20, 35, 45 degrees) which may not be too shallow. Consider going to different style of conveyor belt:
-Fold Over Conveyor Belt = Zero Spillage
-Compartmentized Belt = No Spillage

2. If the problem is too much material initially being dumped onto the conveyor and overflowing, controlling the volume closer would be effective. Perhaps an intermediate holding tank just prior to the chute to make a buffer for times when the material in arriving faster than the conveyor can remove it would help. Minimizing the gap between the chute and the conveyor would be beneficial. A flexible chute such as rubberized cloth etc could be utilized to eliminate the gap between the chute outlet and the conveyor. Likewise, covering the conveyor itself with sections of material over the top (and bottom) of the conveyor trough would help. These could be either removable or attached to the side of the conveyor on hinges to allow for access to the conveyor. (Rubber) seals between the covers and the conveyor would greatly reduce or eliminate leakage between the conveyor and the covers. As to particles floating free of the conveyor, enclosing it as previously mentioned will help this. If the conveyor was enclosed, perhaps a controlled air flow such as a vacuum could be utilized.

Figure 3: Covering inclined section of Conveyor

3. The most cost effective solution would be to install Guides that run perpendicular to the plane of the conveyor and prevent such spillage from occurring. Speeding up the belt is going to cause more coal dust to transfer into the air of your work environment and slowing the rate of feed will also slow production.

Figure 4: Guides at the edges of Conveyor Belt to avoid Spillage

4. Fabricating an Inlet Box typically of size 1.5mtrs length. It need to have sides bolted with rubber/conveyor belt material which touches the belt and prevents spillage to sides. Also, need to put end curtains for sides, but it should not touch the belt.
5. When the source of water is from rain, the best approach is to stop the water from getting on the belt in the first place. This was accomplished with covers. Depending on where the excessive water is coming from with the system (elements or process), If the water is from a processing step, we may have to remove excess water before putting the coal on the belt - this can be done by installing a filter belt system as a feeder to your incline belt.Another option would be to turn your incline belt into a Quasi-Filter Belt . However, it need to have to install a means of handling the water run-off.

6. It would be helpful to know where the water is coming from. If it is coming from hosing out chutes or another intermittent source, then one option is to fit a Plough to the carry side of the belt to remove the water. The plough can be lowered as required, and has an adjustable idler system to level the belt. The water/slurry is directed into a chute on the side of the conveyor and can be collected in a sump or bin.
7. The frequency of "flow backs" was significantly reduced by introducing a "Dewatering" chute at the transfer feeding onto the inclined belt. The chute operated on the different trajectories between water/slurry and the burden, and allowed the water to be "stripped" from the conveyed material.
8. Feed chute incorporating water drainage provision i.e. feed chute bottom is perforated and water dripping is taken out by Pipe. This kind of arrangement has been used for very wet coal at mines or at storage place subjected to heavy rains. This will be feasible only if the coal size is sufficiently large and it is not containing large proportion of fine dust. Or the coal dust will be wasted.

Figure 5: Feed Chute Spillage

9. A Plough must be raised before the coal rips it away. Also, the plough must be located far enough ahead of the pond to accommodate the run down travel; we have to interlock the plough to the drive so that if the plough falls the conveyor stops. We will find that the run down & start up times involve locating the plough so far ahead of the pond that the water will run into the transfer tower anyway. Cleated belts will be notoriously hard to clean from wet coal accretions. The best cleaner for wet coal is a multi blade assembly e.g. Hosch or similar copies. A de-watering chute is quite big box to retrofit.

IV. CONCLUSION

The most of the reasons of Coal Spillage has been covered in this paper, On the basis of which it was possible to find out alternate approaches to avoid Coal Spillage from conveyors. Some of the methods can revolutionize the conveyors systems used in coal handling plants such as stated above, using Quasi-Filter Belts, Plough to remove water from conveyors etc.

If an existing bulk solid conveying system works now, it should continue to work as long as the bulk solid stays the same and the conveyor does not suffer wear that changes its performance. But changes in the source of the coal (e.g. coal bed or colliery), or increased moisture, or changes in the process like increasing the speed of the belts can have consequences on the performance of a belt conveyor. When a bulk solid conveying system is being engineered, the bulk solids it will carry needs to be tested for frictional characteristics at the bulk solid and belt interface to achieve the overall performance required.

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