BELT SWAY CONTROL
FOR A BETTER COAL HANDLING PLANT

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Belt sway is a major irritant for any Coal Handling Plant.

Particularly in a new CHP, a lot of effort is required for overcoming this problem.

In recent past in the newly commissioned CHP of Sipat, Dadri-II, Vallur, even generation loss has been suffered due to this issue.
UNDERSTANDING THE BASIC BELT BEHAVIOR PATTERN

Fundamental rule of belt tracking

- The belt will move toward the side that has more friction
- Or the side that reaches the friction first.
- When a side of the belt encounters that friction,
  - That side of the belt moves slower.
  - Other side moves faster
- Due to imbalance, belt toward slower side.

If an idler is installed at an angle, the belt will move toward the side it reaches first.
This can be demonstrated simply by laying a round pencil on a flat surface.
THE MOST COMMON CAUSES OF SWAY

Faults with the Belt or its Splices

Faults with the Conveyor Structure, Components

Faults with Material Loading
FAULTS WITH THE BELT OR ITS SPLICES

**Belting**
- The belt is **bowed**, cambered, or cupped
- Defects in the carcass, plies or cords.
- Belt edge or cover is damaged
- Belt degradation from exposure to the sun

**Manufacturing**
- **Tension of chords** are different
- Belt was not stored properly

**Splice**
- **Splice**- not square to the belt.
- Belt was formed from several pieces joined
- Different types /thicknesses, /widths of bell spliced together.
FAULTS WITH THE CONVEYOR STRUCTURE, COMPONENTS, OR THE ENVIRONMENT

**Structure**
- The structure was not accurately aligned during erection.
- The structure has settled on one side.
- The structure has been damaged.

**Components**
- Idlers and pulleys are not aligned.
- Idler rolls have seized or missing.
- The gravity take-up is misaligned.
- Material buildup in idlers or pulleys.

**Environment**
- The conveyor is subjected to high winds.
- Rain, snow altered the friction on one side of the belt.
- The sun shines on one side of the conveyor.
FAULTS WITH MATERIAL LOADING

- Eccentric loading on the receiving belt.
- The load is segregated, with larger lumps on one side of the belt.
- Intermittent loading on a belt that is tracked for a constant load.
GTU PULLEY SYSTEM IN PLAN VIEW
(BEFORE)
Guide Pipe was not perfectly vertical
Guide Clamps having more gaps (upto 30 mm) causing X axis, Y axis & Z Axis movement of the pulley

GTU PULLEY SYSTEM IN PLAN VIEW
(AFTER)
Guide Pipe made perfectly vertical
Guide Clamps having less gap restricting, X axis, Y axis & Z axis movement of the pulley
CASE STUDY OF BELT SWAY PROBLEM IN SIPAT CONVEYOR 24 AB

Actual Picture (Before) Sipat

A better designed GTU Guide
Due to reversing, the **tension areas in the belting change location**. The carrying side changes from being pulled to being pushed. The belt may run fine in one direction & sway when reversed,
- different sets of rollers control the steering of the belt.
- Corrections should be made to get all rotating components in alignment.

Other problems - off-center loading, multiple load points.
- Required proper loading-chute design & use of adjustable deflectors,
The first step in training a conveyor is to check and align the structure.

- The traditional method of checking alignment is **piano wire method**
- Now, new technology “Laser”.
- **Laser-surveying** avoids the problems encountered with "piano wire" technique.
  - The laser generates a perfectly straight beam with a long range
  - To check objects set at angles, prisms can be used to bend the beam.
Conveyor Laser Alignment Advantages
This technology is highly accurate (.003" at 500 ft).

Step 1:
Locate the centerline, then offset from the conveyor to one or both sides and establish a masters plane. Monuments are then placed so that the centerline can be re-established anytime in the future.

Step 2:
Establish slave planes. The slave planes are vertical and perpendicular to the master plane.

Step 3:
Establish level planes. The level planes are horizontal and perpendicular to the master and slave planes.

Measurements from the various planes allow to determine alignment of stringers, pulleys and idlers, to insure optimized system performance.
TRAINING THE BELT

Getting the belt to track in the center of the conveyor's structure is a process of adjusting idlers and loading conditions to correct any tendency of the belt to run outside the desired path.

- **The first step is to get the structure into alignment with the belt's theoretical centerline,**
  - Once the structure is aligned, all the pulleys and idlers must be aligned so they are level and square to the center line.
- **Determine Areas of Belt Tension**
  - Adjustments to components in the low-tension areas have the highest impact on correction.
- **Determine Locations of sway**
  - Track of the belt at any given point is affected more by the idlers etc. upstream. This means where sway is visible, the cause of sway is at a point the belt has already passed.

The movement of one idler generally has its greatest training effect in an area within 5 to 8 meters downstream.
TRAINING THE BELT

- To correct the belt's running path, start in the areas of lower tension.
- Observe few complete revolutions.
- Shift only one idler at a time.
- The belt to be tracked empty.
- Adjustments to the idlers should be small. Research at Australia's University of Newcastle has shown that once an idler is skewed past a certain point, it will not correct the belt path more, because the belt slides across the idler.
- Tilt the carrying idlers slightly, up to two deg, in the direction of belt travel.
  - The friction of the belt on the wing rollers creates a centering force.
  - This can be done by inserting a metal washers.
- Training of Replacement Belts.
  - A new belt often has to be gradually "worn in" like a new pair of shoes. All new systems to be run for several hours before the final training of the belt.
VARIOUS HARDWARE FOR TRAINING THE BELT

- Belt Sway switches
- Vertical Edge Guide
- Return Vee Idlers
VARIOUS HARDWARE FOR TRAINING THE BELT

Crowned Pulley

Self Align Idler
**Principle of Operation**

The tracking is achieved in the horizontal plane of the Belt. **As the belt starts to move off-centre it will contact the tapered section of the Tracker Roller.** The shift in weight and differing peripheral rotational speed between the tapered portion of the Tracker Roller w.r.t the centre causes the roller to pivot in the opposite direction about its central point. Since the Tracker Roller is no longer perpendicular to the direction of the return belt travel, the skewed Tracker Roller automatically steers the belt back to its central position.
This trainer employs a unique "pivot and tilt" action that increases tension on the side of the belt that is mistracking, while reducing tension on the opposite side.

• This causes the belt to quickly return to center
• Sensor rollers that detect belt wander, then engage the belt edge, triggering both pivoting and tilting actions
The Tru-Trainer Troughing is based on an enhanced load carrying design which features quicker activation, increased swing and overall better performance.

There is no edge damage and the troughing angle is now adjustable.
**Operation Principles**

- When the conveyor belt sways, the belt edge pushes the touch pulley into a slanted position. Then, the potentiometer in the detector rotates at an angle in proportion to the pulley slant angle.
- The positioner in the motor actuator compares the potentiometer resistance value of the detector with that of the motor actuator, and operates the motor actuator to turn the adjusting carrier in a direction that agrees with the potentiometer resistance value of the motor actuator to correct the sway.
- The adjusting carrier maintains the slant angle after the conveyor belt position has been corrected and the belt edge is no longer in contact with the touch pulley.
INSTALLATION OF BELT TRAINING DEVICES

Training devices should be installed approximately 4 times the width of the belt in advance of the point of mistracking.

The typical places:
- **Just before the belt enters the tail pulley**, to ensure it is centred on the pulley and into the loading zone.
- **Shortly after the loading zone**, to make sure the loaded belt is tracking in the centre.
- **Just before the discharge pulley**, to make sure the belt is in centre before it discharges coal.
The major cause of belt sway in a loaded belt can be attributed to eccentric loading. This problem is a direct fall out of conventional chute design and installation.
PROBLEM WITH CONVENTIONAL CHUTE DESIGN

- Traditionally, little thought given to the chute except
  - The chute was big enough to accommodate the bulk material & minimizing wear.
  - To be generous in size to reduce plugging.
  - To be box like to reduce fabrication cost
  - Chute angles were designed based on the angle of repose, they were prone to build up
- With changes in flow direction and from the downward energy of the material, the chutes would suffer wear in the metal walls and on the surface of the receiving belt.
• Traditionally designed chutes also generates dust by throwing a stream of uncontrolled material off the end of the conveyor.
• The movement of material displaces air.
• The air passes through the material stream, thus dispersing and entraining the small particle of dust.
• Chute is designed for some specific amount of flow.
  • In case of low quantity feeding then the bulk material getting discharged may not be at centre.
• Solution to the problems mentioned above is Engineered Flow Transfer Chute.
Benefits of Engineered Flow:

- **Central load placement**, prevent belt sway, spillage, and belt-edge damage.
- **Reduce dust escape**
- **Increased material flow rate**, no bottleneck.
- **Reduced material buildups** Reduced loading impact, extend belt-life.
Phase 1: Material Analysis
- The first step is testing of the actual bulk material.
- Information obtained - material composition, physical properties, moisture content, lump size range & fines size.
- Analysis of the bulk-material strength at several moisture contents from "as-received" to "saturation" level.
- Three different types of tests, - direct shear, interface friction, and bulk density; at each of these moisture content levels.

Phase 2: Discrete Element Modeling (DEM) Method
- The parameters of Ph-1 used in developing a computer-generated 3D discrete element model of the chute

Phase 3: Final Design
- Computer-based modeling techniques allow the quick and efficient chute design. The 3D model is used to produce the fabrication drawings.
As engineered flow chutes are likely to be installed in future plants only, we have to live with conventional chutes. For correction of eccentric loading we have to restore to fixing of deflector plates. In many of the Coal handling plant massive belt through cuts have been experienced due to dislodging of deflector plate due to welding failure. In the following figure sketch of deflector fixing procedure by welding the deflector plates in both inside and out side of the chutes has been shown.
Thank You