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Conveyor Belt Troubles

(Bulk Material Handling)

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Abstract: *There are two main industrial classes of belt conveyors; those in general material handling such as those moving boxes along inside a factory and bulk material handling such as those used to transport large volume of resource and agricultural materials. Conveyor belt maintenance not only includes proper care of the belt itself but also includes care and maintenance of the frame and accessories. The same way life of a conveyor belt not only depends on good design and manufactures but also on the care and attention it receives in storage and service.*

The main damages are occurring in bulk material handling system due to the sticking of the material which is transporting and the damages due to the chemical reaction and also there causes failure due to carry back of product. The problems and failures need a permanent maintenance. The removal of sticking materials can be done by two methods, by using a wire brush which is placing under the conveyor belt; it will remove the sticking materials when the conveyor rotates. There is one more solution for this is problem to use a water spray under the belt conveyor belt for the sticky materials

1. INTRODUCTION

1.1. Belt Conveyors

Conveyor belt came into vogue around 1868 when lyster an English engineer described to British engineering socketing bulk materials by endless belts made of rubber faced canvas. A belt conveyor has the advantage of simplicity of construction, high efficiency and low power requirements and economic in upkeep. It may be horizontal or inclined or a combination of both can be arranged to convey material either up or down and inclined.

These are mainly two type of conveyor belt :- flat and troughed. A flat belt is generally used for bag; bottle, box and other packaged materials although under certain conditions loose material in bulk, such soap may also be satisfactorily handled. A troughed unable the loading capacity to be increased over 60% without danger of spillage and suitable for almost any bulk material in a dry, damn or spillage and is suitable for any bulk material in dry, damn or semi wet condition. The life of a conveyor belt not only depends only on good design and manufacture but also on the care and attention it receives in storage and service.

Belt life is often shortening by one or a combination of following factors which can all we avoided:

- Neglecting to obtain the manufactures advice before buying a belt for difficult or unusual conditions.
- Buying a poor grade of belt because it is cheap in first cause, though not suited to be work expected of it.
- Injury to the cover or edges by carelessness during installation of the conveyor.
- Joint not square with the belt, thereby causing the belt to run crooked and the edges to wear.

- Neglecting to use that heat resisting belts for carrying hot materials.
- Inadequate loading chutes, causing jams and jammed materials prematurely wearing belt covers.
- Not providing rubber impacts idlers at the loading section where the materials carries is large and lumpy.
- Neglecting to repair immediately any damages to cover or fabric.
- Inadequate lubrication of idlers, causing belt cover deterioration due to contamination.

1.2. Different Components of Belt Conveyors

The different components of the belt conveyor system are

a) The conveyor belt:

Belt is main part of the belt conveyor system. In belt conveyor system materials are transported from one station to another through these belts. Belts are generally classified according to British standard specification No.490 into three groups A, B and C. Grade A is used in severe abrasion or cutting action. Grade B is used in moderate conditions of abrasion or cutting. The different types of conveyor belt are the following;

a. Untreated cotton canvas belts.
b. The impregnated cotton and canvas belts.
c. Coated belts.
d. Covered belts.
e. Reinforced belts.
f. Integral cleat belt.
g. White finishes belts.

The belt conveyor system (BCS) consists of:

- Drive unit (electric motor, coupling multistage gearbox)
- Pulleys (drive pulley and other)
- Belts (textile or with steel cords) with their joints
- Idlers
- Other (belt cleaning systems, control system, etc)

Belt conveyor may be viewed as a part of bucket wheel excavator or dumping machine.

b) Drive Unit:

The drive unit consist of electric motor, damping coupling, two or three stage gearbox and coupling that connect output shaft with pulley. A crucial object in this subsystem is gearbox. According to the industry even 14% of gearboxes may be replaced each year due to unexpected failures.

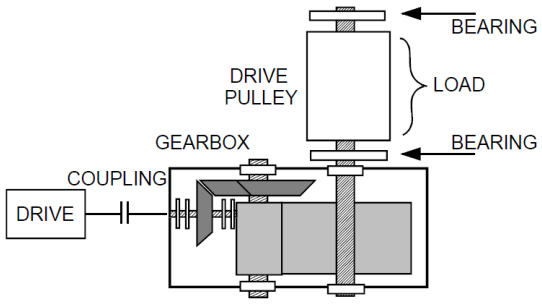


Fig 1.1. *Drive Unit*

c) Pulleys:

Pulleys are generally made of steel fabricated construction. The pulley shell is connected to the two hubs one at each ends with the help of two diaphragms. Rubber lagged pulleys are supplied to increase the friction in between the belt and the pulley. The lagging is either plain or herring plain bone grooves.

The mining pulley consists of two bearings, shaft, shell and coating (special material in order to improve belt-pulley contact).

d) The idlers:

The idlers consist if seamless steel tube rolls enclosed by pulley heads at each end and fitted with stationary shaft, anti-friction bearing and seals. The generally used idlers are:

- Toughing idler
- Toughing trainer
- Return idler
- Return trainer
- Impact idler.

The failure analysis of idlers and belts are a bit different issue. Idlers are used for supporting belts with transported materials. In some sense idlers are similar to pulleys and consist of bearings and shells. One may expect similar types of failures. The support system for belt consists of three idlers. Because of different load for each idler usually side idlers are more subjected to damage. It needs to be added that in CM context of idlers change of condition is not the only one. Worn bearings in idlers will significantly increase external load for drive units so power consumption will increase. Damaged idlers and pulleys may be the reason of damage for belts.

Figure 1.2. *Types of Idlers*

e) Take-ups:

Belt conveyors are provided with take ups which perform the following functions:

- Maintain necessary slack side tension for the drive to operate the belt.
- Keep sag of the belt between the idlers at appoint when required horse power will be at a minimum and load will move with least disturbance over idlers.
- Permit length variation due to belt elongation or shrinkage.

The following types of takes-ups have been used.

- Screw take ups: In this take ups the tail pulley bearings are mounted on guides. The bearing mounting are moved manually by single screws by which the tension on the belt can be varied suitably.
- Vertical gravity take-ups: This is the common type of automatic take-ups.the take up pulley bearings are usually mounted on a yoke which moves vertically along two posts guides. Extra weights can be added to the take-ups as requirements to maintain the belt tension.

f) Skirt boards:

Skirt boards are used in conjunction with delivery chutes at tail end of the conveyor, to guide the material while loading. It essentially consists of a fabricated frame firmly supported on the conveyor structure. A skirt rubber is attached at the bottom keeping uniform pressure on the belting.

g) Scraper:

Scrapers are provided at the discharge pulley to clean the carrying side of the belt and to avoid the wear of return idlers to build up of material. A scraper is provided at the tail end pulley to clean the inner surface of the belt and to avoid any material going inside the gap between tail pulley and belt. Generally steel blade or rubber / fabric scrapers are used.

h) Safety devices:

The following safety devices are normally incorporated in the belt conveyor systems.

- Anti-roll back devices.
- Limit switches.
- Zero speed switches.
- Sequence protection switches.

1.3. Basic Structure

A conveyor belt (or belt conveyor) consists of two or more pulleys, with a continuous loop of material - the conveyor belt - that rotates about them. One or both of the pulleys are powered, moving the belt and the material on the belt forward. The powered pulley is called the drive pulley while the unpowered pulley is called the idler.

There are two main industrial classes of belt conveyors; those in general material handling such as those moving boxes along inside factory and bulk material handling such as those used to transport industrial and agricultural materials, such as grain, coal, ores, etc. generally in outdoor locations. Generally companies providing general material handling type belt conveyors do not provide the conveyors for bulk material handling. In addition there are number of commercial applications of belt conveyors such as those in grocery stores .The belt consists of one or more layers of material. They can be made out of rubber. Many belts in general material handling have two layers. An under layer of material to provide linear strength and shape called carcass and an over layer called the cover. The carcass is often cotton or plastic web or mesh. The cover is often various rubber or plastic compounds specified by use of the belt.

1.4. Conveyor Technology

A conveyor belt (or belt conveyor) consists of two or more pulleys, with a continuous loop of material - the conveyor belt - that rotates about them. One or both of the pulleys are powered, moving the belt and the material on the belt forward. The powered pulley is called the drive pulley while the unpowered pulley is called the idler. There are two main industrial classes of belt conveyors; those in general material handling such as those moving boxes along inside a factory and bulk material handling such as those used to transport industrial and agricultural materials, such as grain, coal, ores, etc. generally in outdoor locations. Generally companies providing general material handling type belt conveyors do not provide the conveyors for bulk material handling. In addition there are a number of commercial applications of belt conveyors such as those in grocery stores. The belt consists of one or more layers of material. They can be made out of rubber. Many belts in general material handling have two layers. An under layer of material to provide linear strength and shape called a carcass and an over layer called the cover. The carcass is often a cotton or plastic web or mesh. The cover is often various rubber or plastic compounds specified by use of the belt. Covers can be made from more exotic materials for unusual applications such as silicone for heat or gum rubber when traction is essential.

Material flowing over the belt may be weighed in transit using a beltweigher. Belts with regularly spaced partitions, known as elevator belts, are used for transporting loose materials up steep inclines. Belt Conveyors are used in self-unloading bulk freighters and in live bottom trucks. Conveyor technology is also used in conveyor transport such as moving sidewalks or escalators, as well as on

many manufacturing assembly lines. Stores often have conveyor belts at the check-out counter to move shopping items. Ski areas also use conveyor belts to transport skiers up the hill. A wide variety of related conveying machines are available, different as regards principle of operation, means and direction of conveyance, including screw conveyors , vibrating conveyors, pneumatic conveyors, the moving floor system, which uses reciprocating slats to move cargo, and roller conveyor system, which uses a series of powered rollers to convey boxes or pallets.

Fig 1.3. *Conveyor Technology*

2. PROBLEM IDENTIFICATION

- Some sticky materials present a real challenge when it comes to preventing carry back.
- The belts may be reversed to allow better release at the discharge point.
- A dual scraper system on the head pulley is the most common way to eliminate product carry back.
- A water spray on the belt cover along with wiper blades will effectively remove most products from sticking to the cover.
- The most frequent failures for pulleys are: bearings and shells. For gearboxes number of failures related to geared wheels is 50%.
- Other critical failure is the damage of input shafts (probably because of overloading). It may be surprising that bearing faults are not so frequent in gearboxes.

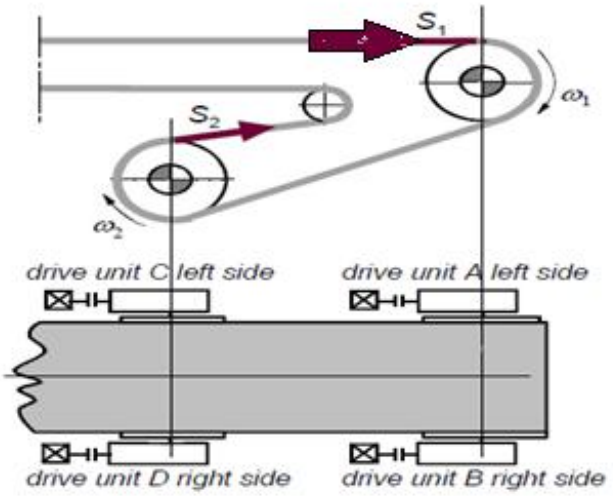


Fig 1.4. *Driving Unit*

2.1 Failure of Conveyor Belt

The failure of the conveyor system is not only due to the damage of the belt but also due to the errors occur in related parts, such as pulleys, motor, shaft, bearings, etc.

Figure 2.1. *Corrosions affected drum*

For gearboxes number of failures related to geared wheels is 50%. Other critical failure is the damage of input shafts. Most of the failures caused to related parts of conveyor belt will be due to some reasons like overloading, rough loading, and due to some input problems. The action of the chemical is also causes the failure in the related parts of the conveyor belt. The constant maintenance is very important to avoid these failures which causes very huge loss to the company.

3. MAINTENANCE

Definition

It is defined as the set of activities on all plants and machineries, to maintain the same at prime condition in economic ways, for smooth running of plants for the achievement of organizational objectives. Prime condition refers to that the plant and machinery shall be in good condition for efficient and effective utilization of the same for the functions for which it is designated and installed for.

Objective

To ensure the maximum availability and reliability of their plant and machinery at an optimum cost for uninterrupted operation of all units for the achievement of organizational goals with respect to targets and to meet standards of environment, safety and ISO's standards and conditions.

3.1 Types of Maintenance

Maintenance is classified mainly on the basis of nature of activities performed.

a) Preventive Maintenance

It is the set of activities performed on equipment periodically by improving the operational atmospheres, to prevent any possible failures. The activities performed are checking of all fasteners and bolts, checking of lube oil conditions, checking of other ancillary facilities like cooling water, seal cooling system, seal quenching system, operating parameters like suction pressures, temperature, discharge pressure, any abnormal noise, condition of seals or packing's etc. The abnormalities are corrected without disturbing the functioning of the plant. Preventive maintenance check depends upon the criticality of the equipment.

- **Critical equipment-**

  These are the running equipment having standby but whose failure will affect the production of the plant directly. For these equipment Predictive maintenance is done once in 15 days.

- **Semi-critical equipment**

  These are having standby and are used in production line. Predictive maintenance check is done once in 30 days.

- **Non critical equipment**

  These are not in production line and are used as standby. They are checked once in 3 months.

b) Predictive Maintenance or condition monitoring

The main step is to monitor the condition of the equipment under operation. This includes observation and data collection on equipment's, which are on line. The collected data will be analyzed and possible abnormalities are derived and corrective measures are prescribed. All machines vibrate in

operation. If any problem occurs there will be an increase in vibration. The unique characteristic of increased vibrations can be analyzed and the problem developed in the equipment can be determined by the nature of the vibration. To cover all equipment of plant under condition monitoring each equipment is grouped based on its criticality/plant and a schedule is drawn to cover all equipment and condition monitoring is performed on these equipment's as per schedule. The set of activities carried out are:

Physical observation of the machine in operation, the engineering parameters like RPM, bearings, no. of blades or vanes, belt, coupling type, lubrication type, process fluid, mounting conditions are checked and noted down. For gear boxes, no. of teeth and rpm and for electric motors, KW rating, Volt and current, rpm are noted. The history of machine also is studied. After this the vibration data collection is done on the machines and the following four stages of the condition monitoring is done on the machines.

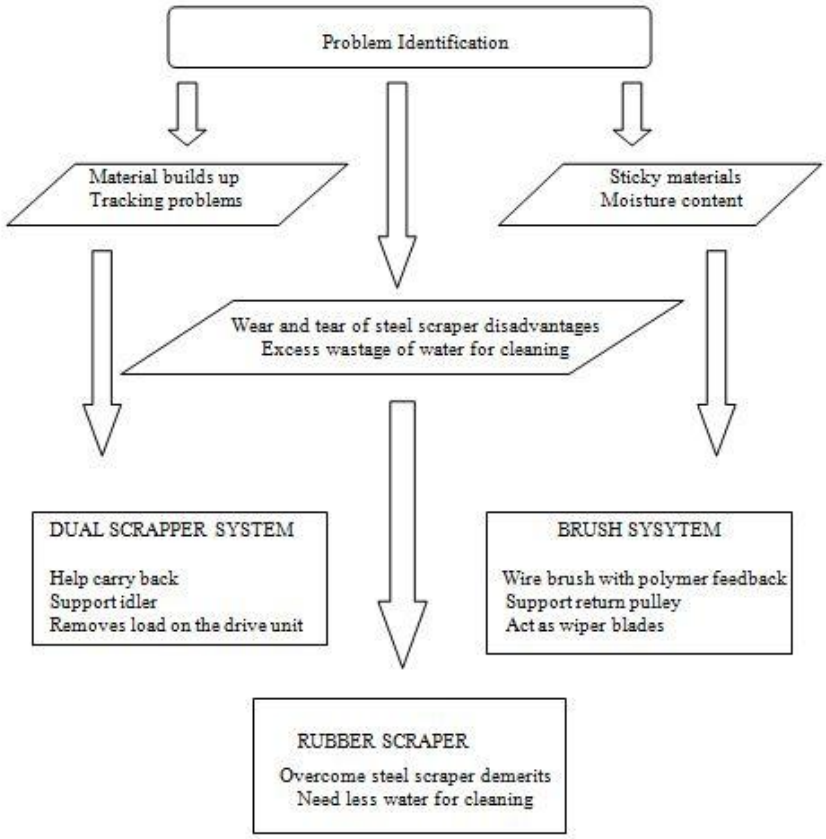
- Detection
- Analysis
- Correction
- Verification

c) Corrective Maintenance

It is the overhauling of equipment, checking alignment etc. Overhauling of equipment is done by removal of equipment, dismantling/disassembling, inspection of parts, replacement of parts as found necessary, reassembling and reinstallation. After reinstallation of equipment alignment of the driver and driven equipment is carried out and then coupled.

Corrective maintenance is of two types - Planned and unplanned

i) Planned corrective maintenance:-



Planned corrective maintenance is adopted when trend (vibration, performance etc.) shows deterioration in health of equipment. During annual turnaround the critical equipment like centrifugal compressor, turbine, critical centrifugal pumps, reciprocating compressor, slide valve etc. are inspected and necessary corrective actions are taken.

Periodic condition monitoring indicates health. If trend indicates that there is constant increase in vibration level, noise level etc or the flow has gradually reduced, the problem is analyzed. Analysis reveals a problem increase in misalignment or increase in deterioration of bearing etc. The loss of

flow may be due to suction strainer blockage, increase in internal clearance etc. Appropriate corrective actions are adopted. If needed a total overhaul is carried out.

ii) Unplanned corrective Maintenance:-

Unplanned corrective maintenance is adopted when failure of equipment occurs. Overhauling is carried out depending on nature of failure. Overhauling refers to dismantling of parts, inspection, and replacement of worn out parts and reassembling of parts. During reassembling the important points are taken care of is the replacement of worn out parts, restoration of internal clearances and centering of the rotating element with respect to stationary element both in radial and axial direction.

d) Mechanical Maintenance

a. Cleanliness

Both exterior and interior of every machine should be kept free from dust oil and moisture. Dust can have a harmful effect if it is allowed to settle on the windings, to enter the bearing or to collect in the ventilating passages. Motor should be blown out periodically depending on the atmospheric conditions at site.

b. Lubrication

The original grease should not be removed unless the grease has become dirty or has deteriorated. The hands must be perfectly clean and smeared with good quality material oil before any bearing is handled.

A small quantity of old grease will unavoidably be left in the bearing and if this is clean and in good condition it should be left rather than washed out with petrol to which a small quantity of lubricating oil has been added. Before a bearing is packed with grease, a few drops of clean lubricating oil should be introduced into the bearing. Lithium based multipurpose grease conforming to Grade 3 of ISO 1002-1956 amended up to date , is recommended for all machines fitted with antifriction bearings. The approved grease is Castrol Ball Bearing Grease AP3.This safe operating temperature range for the above grease is -25 to 120 degree Celsius (approx. value).

c. Bearing replacement:

Before replacing the bearings it is recommended to heat the new bearings in medium oil say ‘shell Tellus-33’ at a temperature not exceeding 90 degree Celsius for about one hour to enable easy mounting by push fit and avoid hammering of bearing which may result in premature failure of the same. When bearings are removed from the motors or uncovered due to partial dismantling, wrap them in a clean journal immediately to keep them free from dirt.

4. METHODOLGY

4.1 Dual scrapper system

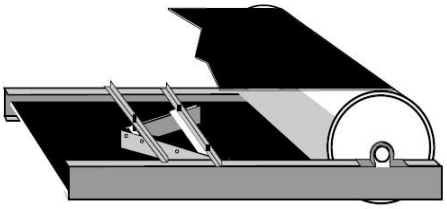


Figure 4.1. *Dual Scrapper System*

A conveyor system with carry back on the return side is the single biggest reason that conveyor belts are replaced, return idlers and pulleys are replaced and structure is worn through. Material build up on the belt and hardware causes tracking problems that will lead to edge damage that leads to new belt and new idlers. We urge you to use scrapers on the head pulley and plows in front of the tail pulley as

prevention for damage in your maintenance planning. Some sticky materials present a real challenge when it comes to preventing carry back.

We would like to offer a few additional suggestions as to handling these products. Cleated belts may be reversed to allow better release at the discharge point.

4.2 Brush System

A water spray on the belt cover along with wiper blades will effectively remove most products from sticking to the cover. A series of out of round (cam shaped) return idlers will also assist in cleaning. These idlers are spiral wound from the edges towards the center of the idler and work on the premise of a turning beater bar arrangement. A compressed air blast has been successfully used on material like coal and fine wet sand. A power driven revolving brush will help remove product from the belt. This method is rarely used because the bristles tend to clog up with material and wear out quickly. A brush may be the only solution for cleated belts. Product build up on return side pulleys is a major concern.

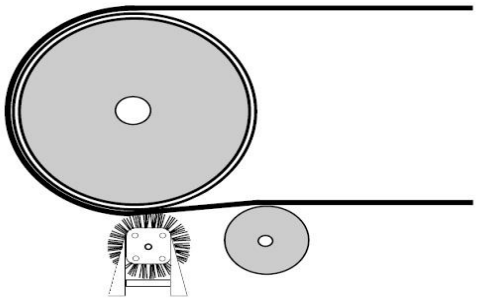


Fig 4.2. *Brush System*

If your belt is not effectively clean on the return run, then any bend pulleys or head snub pulley that come in contact with the carry side of the belt will accumulate product. We would like to offer a few hints on pulley and idler cleaning. All return side pulleys that come in contact with the carry cover can be lagged with a soft rubber vulcanized to the pulley. The constant flexing action of the soft lagging will cause material to fall off and reduce material accumulation. A lever weighted urethane scraper pressed against the pulley face, is an excellent way to remove build up. This system causes additional wear on the pulley face so it is suggested to use heavier walled return bend pulleys when using a scraper. If a scraper is applied to a head snub or bend pulleys at the take-up area then deflector plates will have to be installed.

4.3 Rubber Scraper

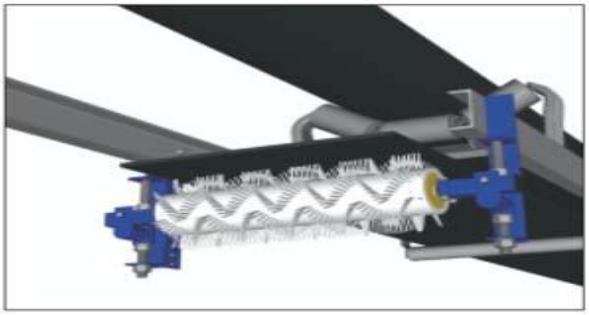


Figure 4.3. *Rubber scraper*

Keeping the return rolls and snubs clean requires that the belt be clean when it enters the return run. Scraping is the most common method of doing this rubber scrapers can be made by clamping rubber slabs ½" to 1" thick between two metal or wooden bars. Extend the rubber about twice its thickness beyond the bars and suspend the mechanism with a counter-weight to provide the pressure against the belt. Replace the rubber when it wears down near the bars. Two or three such scrapers can be used in succession.

The most common steel scraper is a series of diagonally set blades mounted on the end of a leaf spring to maintain pressure against the belt. These will scrape sticky materials which rubber scrapers may ride over. It is preferable to clean just after the head pulley and before the snub. An exception to this is that sticky material often requires scraping on the head pulley. This is because a large part of the fine material sticks to the belt and must be scraped into the chute. Washing the belt with a water spray before wiping with a rubber scraper will do a good cleaning job on almost any material.

5. CONCLUSION

The problems were found in different conveyer system was improper alignment of idlers, belt running off at tail pulley, excessive wear on bottom of belt and corrosion in the frame.

We implement the strategy of preventive maintenance as the first step of our project, by this maintenance future maintenance cost is saved. Regular maintenance and proper lubrication can keep maintain alignment of idlers. Adjust loading material to properly center the load helps in reducing belt running off at tail pulley. Greasing and painting can reduce corrosion in frames and drum. Use of dual scrap system, brush system and rubber scrapper helps in effective running of the conveyor belt. By following these methods the tendency to breakdown maintenance reduces and gradually the yearly maintenance cost suppresses thereby profiting the companies.

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