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Research Paper

SAFETY MEASURES FOR REDUCTION OF FAILURE IN BELT CONVEYOR FOR THERMAL POWER PLANT

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This paper is a study compared with the actual situation of thermal power plant for increasing the safety measure by which the failure rate of conveyor belt in the thermal power plant, used for coal handling can be reduced. This study is made to reduce the failure chances in the belt of a belt conveyor by adopting several safety measures and installing various safety devices available for ensuring the longer life of conveyor belt with minimum failure possible.

Keywords: Conveyor belt, Belt deviation, Safety instrument

INTRODUCTION

Belt conveyor is the most economical and efficient material handling equipment which can be implemented in the thermal power plant for coal handling, belt conveyor mainly consist of three parts, i.e., belt, roller or idlers and the support frame. The material is carried on the belt and the rate of failure of belt is much more then the failure of the other parts, the failure in other part has direct or indirect impact on the belt of conveyor. The cost of the belt is about 25~50% of the total cost of the conveyor system. So measures are to be adopted for the protection of the belt from failure and to ensure safe and longer life of the belt.

The research has been carried out in the thermal power plant so as to ensure that failure does not impact on the material handling rate of coal in coal handling plant. Previously research has been carried out on overall conveyor system but the focus must be carried toward the belt as it is more costly part of the conveyor and damages frequently.

BELT CONVEYOR

A belt conveyor system consists essentially of an endless belt of resilient material connected between two flat pulleys and moved by rotating one of the pulleys by electric motor. Normally, material is fed on the belt near the other end pulley, the moving belt carry the material toward the driver pulley is likely to sag between two end pulleys due to its self weight and pay load that is why the belt is supported on the carrying side as well as on the return side by a number

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of rollers called idlers. As the belt is always under tension, it is prone to elongation resulting in the slackness over the pulleys and loss of tension and power. That is why some kind of device for tensioning the belt is incorporated in the system. This tensioning device is known as take-up arrangement. The system is inherently very simple.

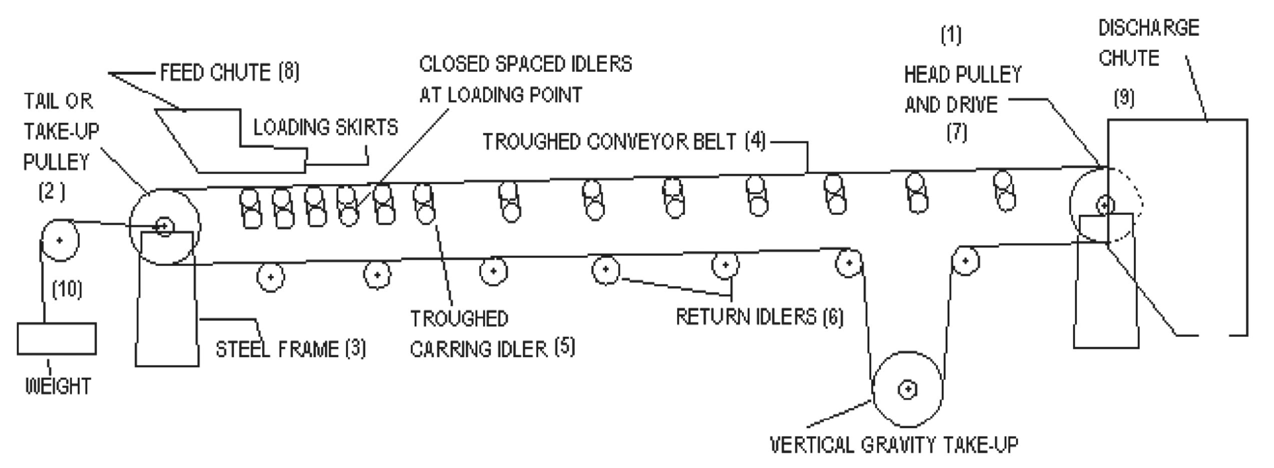
Belt conveyors have attained a dominant position in transporting bulk materials due to a number of inherent advantages like the economy and safety of operation, reliability, versatility and practically unlimited range of capacities. Belt conveyors can deliver materials at a great distance from the loading point covering all odd terrain.

COMPONENTS OF BELT CONVEYOR

Figure 1 shows the general arrangement of the belt conveyor system. The essential features of a belt conveyor system can be described with reference to Figure 1. It consists of a driving pulley at the head end (1) and a take-up pulley (2) at the tail end, both being accommodated in a steel frame (3). An endless belt (4) connects the two pulleys on both ran and supported with suitable roller-type support called idlers. At the upper side of the conveyor, also called the carrying side, because the pay load is carried on this side, the belt is supported by the idlers (5). At the other side, also called the return side because usually there is on pay load, the belt is supported on the idlers (6). In some designs the belt is supported by a stationary runway instead of idlers. In some special installation both the upper side and lower side transport loads simultaneously in opposite directions. The driving pulley (1) receives its rotation from the drive unit (7).

The material is to be conveyed is loads on the belt by one or more feeder-hoppers (8), mounted over the conveyor belt line and normally placed at the tail-end side. The load conveyed by the is discharged over the driving pulley (1) into the discharge spout (9) However discharge can be arranged at any point along the conveying run by means of special discharge device. At the tail-end side a device called the take-up arrangement (10), is attached with the take-up pulley (2) to keep

Figure 1: Essential Parts of a Belt Conveyor



the belt under a minimum tension, so that the belt does not slip over the pulley due to extension of its length. Belt cleaner removes material adhering to the outer surface of the belt face. It is usually located near the driving pulley (1).

BELT

Conveyor belt is the most expensive but the least durable part of a conveyor. During the working process of a conveyor, the loading effect with distinctive nature and in variable size is acted on the belt, which makes the belt in a complex state of stress. There are several kinds of typical damage forms of the belt: the working surface and edges are worn, striking, tearing and peeling caused by the impact of big ore particles; belt core suffers from fatigue due to alternating bending via the idlers, the intensity index decreases and ageing because of the effect of environment medium. The conveyor belt expenses account for half of that of all the equipment of a conveyor. Hence, choosing a suitable belt according to the conditions where the conveyor will be used, enhancing maintenance and management during the working process are essential to prolong the belt's service life, to boost the conveyor's efficiency as well as to reduce the cost of manufacturing the conveyor.

The various failure of belt and the safety measures are discussed in detailed in the research paper, these are:

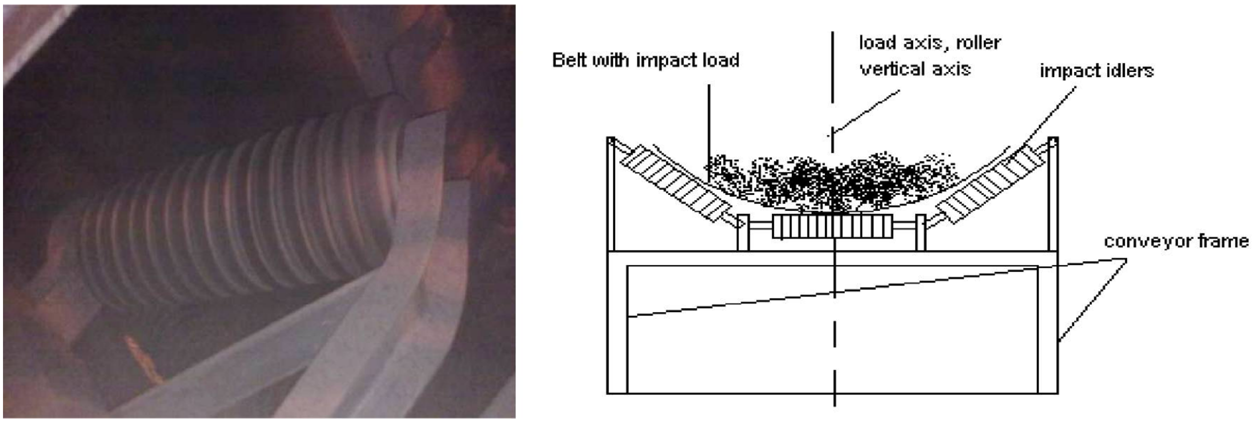
At Loading Point

The transfer of coal to the belt conveyor is done through feeder-hopper, the feeder-hopper must have an iron-grid installed at its mouth, So that the coal of large lump size does not get directly filled in feeder-hopper from the wagon tippler and get transferred on the belt of conveyor (Figure 2). The belt might get ruptured due to high amount of weight and impact force.

Figure 2: Iron-Gird with Large Lump Size of Coal

This size can produce the wear and tear in the belt, and can damage the support system so that again and again the belt might get wear from the support system. The coal passing from the iron-grid must be loaded to the vibrating screen so the coal can gain same momentum as that of conveyor belt and then the coal must get transferred to the belt conveyor.

Figure 3: Impact Idlers Installed at Loading Point of Coal



The belt conveyor at the point of loading must be empowered with impact idlers so that they reduces the impact wear of the belt due to load force created by the coal at the time of loading on the belt conveyor (Figure 3).

THE START AND STOP OF BELT CONVEYOR

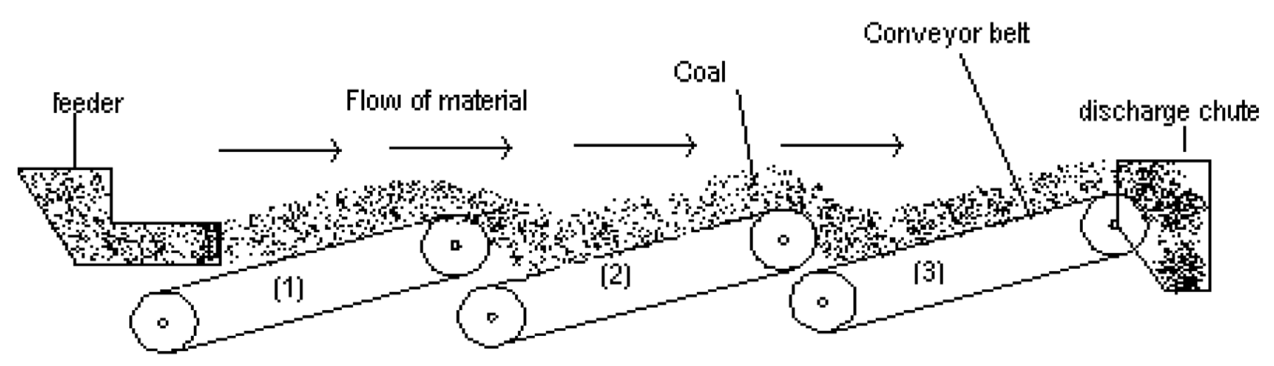
The conveyor must be stated with no load i.e. the belt of the conveyor must be empty at the start of the conveyor belt run. And the stopping of the belt must also be with no load. But at the time of accident or emergency the belt is stopped with load and after that the starting of the conveyor is loaded start-up. The loaded start-up requires higher force which is provided with the electric motor and fluid coupling with gear box arrangement but it must be checked that this kind of stopping of belt must be avoided so that the damage to the coupling, gearbox, motor and the belt can be avoided. For emergency stopping of the belt conveyor the pull-string switch is provided along the length of the conveyor system but the starting of conveyor system is done from the main control room.

INTERLOCKING PROTECTION TO THE BELT CONVEYOR

In thermal power plant the conveyor belt must be installed with a programmed interlocking protection system so that the damage to the belt can be reduced. In programmed interlocking protection the sequence of start-up of each conveyor is fixed, i.e., the last conveyor starts first and then the second last conveyor is started and so on.

Similarly programmed interlocking protection provide the sequence of stopping of the belt conveyor, i.e., the first conveyor is stopped first, then the second one is stopped and so on. This is done to avoid the damage of belt due to loaded start-up and from getting extra loaded at the time of uneven start-up.

Figure 4: Interlocking Protection in Belt Conveyor



Interlocking protection can be understood from the Figure 4. As the stopping of the belt is done in the sequence starting from conveyor (1), then conveyor (2) is stopped and then at last conveyor (3) is stopped. Similarly starting of the belt conveyor is done in the sequence, starting from conveyor (3), then conveyor (2) is started and then at last conveyor (1) is started.

At the time of accident or at the time of any emergency then all the system is made to stop-still and the conveyor with the fault or breakdown is started in counter-clockwise to make it unloaded. And then after rectification of problem the direction of the conveyor is again changed and the conveyor system again works normally according to the programmed interlock protection.

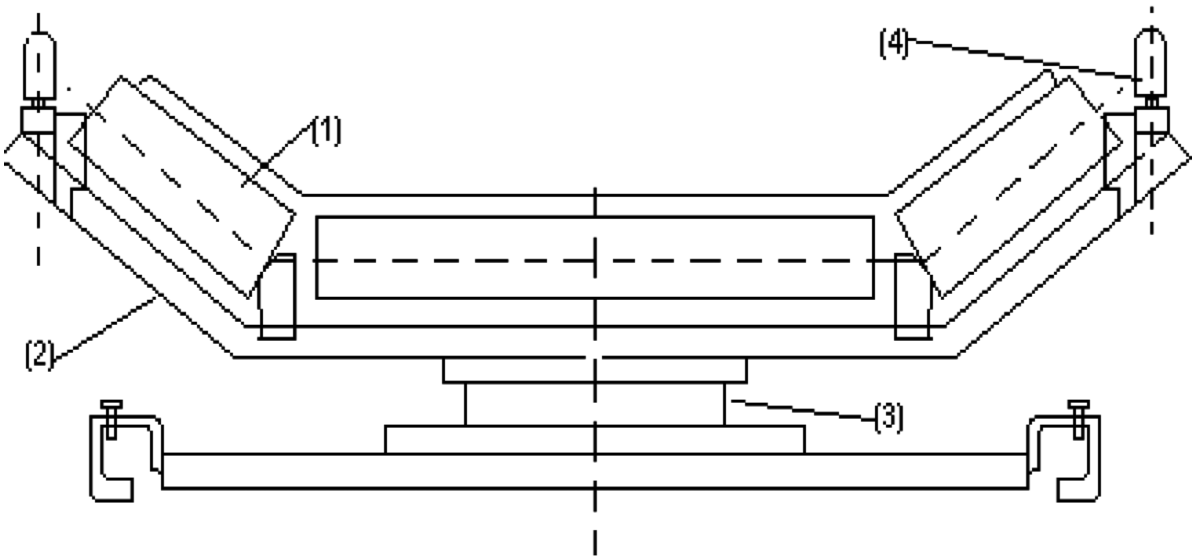
BELT DEVIATION

Deviation of belt is the movement of belt from its centerline toward outside during the run time. This movement of the belt causes the rack wear on the edge of belt and reduces the overall life of the belt. This deviation in the belt is generated due to:

- One side loading of coal from feeder, i.e., feeder arrangement is improper.
- Improper cleaning of the belt causes difference in the diameter of the roller causes deviation.
- Roller and the roller axis with the center of the belt is not installed vertically may cause deviation in the belt.
- Level of the roller on both the side of the troughed arrangement is not equal.
- The joints in the belt may cause the deviation to occur.

Devation of the belt can be reduced by using a set of self-aligning-idler. The arrangement of self-aligning-idler must be installed at the carrying side and return side at an interval of 15 m on the carrying run and 30 m at the return run. Figure 5 shows the design of a training idler. It consists of an ordinary troughed three roller idler (1), mounted on swivel frame (2), which is free to swivel within a limit about a vertical pivot (3). When the belt shifts off the centre, the edge contracts on actuating roller (4) with a slight pressure, and makes the idler take a skewed position when a force acts which tends to steer the belt back to its central position. As the belt return to its central position, it automatically returns the idler to its initial position.

Figure 5: Centering Idler or Self-Aligning-Idler



The installation of self-aligning-idler reduces the deviation of the belt along the center-line hence it reduces the failure of belt conveyor due to rack wear.

BELT SLIP

Under load belt gets elongated and has the tendency to slip from the pulley which damages the pulley as well as the belt. This can be reduced by using correct take-up arrangement. The automatic take-up is the most desirable as properly maintained it will ensure correct tension of the belt in all operating conditions including starting, running and braking. If for any reason the automatic travel becomes restricted or jammed, belt slippage at the drive may occur, which may cause extreme damage to the belt.

The manual take up has the advantages of compactness and low cost. It is however, unable to maintain optimum tension through normal operating conditions. This includes starting, running stopping and changes in belt length caused by changes in ambient and operating temperature. Manual take-up should therefore only be used on short centre or low-tension conveyors.

BELT CLEANER

When the belt's working surface bypasses the unloading drum, it is impossible to clean the scattered material completely, especially when the material is moist. If this residual material is not swept away, belt is easily broken due to the extrusion of the residuals when it passes the return pulley or idlers

Table1: Percentage for the Movement of the Belt on the Run

Belt Run Off at Tail Pulley	Belt Run Off at Any Point on the Line	Belt Run Off at Head Pulley	Belt Slip	Other
29%	21%	16%	18%	16%

Figure 6: Installed Belt Cleaner at Driving Pulley

(Figure 6). Hence, the cleaner is meaningful in prolonging the using life of the belt.

CONCLUSION

This is the study made for reducing the failure of the conveyor belt by using various safety measures and installing of equipments required increasing the safety of a belt and these safety equipments maintain the belt in all operating conditions hence helpful in reducing the failure of the belt and are meaningful in prolonging the operational life of the belt.

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