Failure Analysis and Prospects of Modification in Industrial Belt Conveyor System- A Review

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Abstract— Belt conveyor is the transportation of material from one location to another. Now a day’s belt conveyor system not only used in mining industries but also applied in cement industries, power plant, food industries, production industries etc. Compared with actual situation of the thermal power plant, this paper presents the review of typical failure in the belt conveyor and maintenance of coal handling system in thermal power plant. Analyze the technical characteristics of coal handling system and operating characteristics of relevant machinery and equipment and describes the maintenance method of prevention and elimination failure to ensure the operation of belt conveyor. The focus is on methodologies as design modification, drum and pulley failures, belt design and its failure. Then the safe operation of coal handling system and the proper method of the equipment maintenance are summed up. Analysis the cause of failure, proposed some effective methods to solve the problems.

Key words: Belt Conveyor, Failure Analysis, Pulley, Design Modifications, Solutions

I. INTRODUCTION

Belt conveyor is a commonly used equipment of continuous transport; it has a high efficiency and large conveying capacity, it can be achieved at different distances, different materials transportation. It is widely used in coal handling system in thermal power plant and other projects. Conveyors are especially useful in applications involving the transportation of heavy or bulky materials. Conveyor systems allow quick and efficient transportation for a wide variety of materials, which make them very popular in the material handling and packaging industries. They can move loads of all shapes, sizes and weights. Also, many have advanced safety features that help prevent accidents.

A belt conveyor system is one of many types of conveyor systems. A belt conveyor system consists of two or more pulleys (sometimes referred to as drums), with an endless loop of carrying medium - 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 pulley.

The belt consists of one or more layers of material. 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 woven fabric having a warp & weft. The most common carcass materials are polyester, nylon and cotton. 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.

II. BELT CONVEYOR SYSTEM

The belt conveyor system consists of
- Drive unit
- Pulleys
- Idlers
- Belts

A. Failure in Conveyor Belt System:
Appears in belt conveyor system with reference to conveyor components. It will be focused mainly to drive units, pulley, idlers and belts as the most significant components. It should be noted that there are nearly no investigation in this area.

1) Drive Unit:
The drive unit consist of electric motor, damping coupling, two or three stage gearbox and coupling that connect output shaft with pulley (fig). A crucial object in this subsystem is the gearbox. According to Matuszewski [1] in a considered lignite open coal handling system even 14% of gear boxes may be replaced each year due to unexpected failures. These failures are related to the geared wheel wear or damages (broken tooth) and bearing (mainly over limit backlash due to environmental impact, also typical failures like outer/inner race, rolling element).

Fig. 1: Example of Damaged Geared Wheel

2) Pulleys:
The pulley consists of two bearing, shaft, shell and coating (special material in order to improve belt-pulley contact)
3) Idlers:
The failure analysis of idlers and belts are a bit different issue [3, 4, and 6]. Idler are used for supporting belt with transport materials. In some sense idlers are similar to pulleys and consist of bearing and shell. One may expect similar types of failures. The support system for belt consists of three idlers. Because of different load of each idler usually side idlers are more subject to damage. Worn Bearing in idlers will significantly increase external load for drive units so power consumption will increase. Damaged idlers and pulleys may be reason of damage for belts.

4) Belt:
Depends on application, belt used in conveyor system may be divided into two groups: textile belts and steel cords belts. In coal handling thermal plant usually textile belts are used. Expected problems for belts are related to belt (tear, puncture, cut of belt and abrasion of bottom/top covers) and its joints (connected using glue, vulcanized or mechanical joint) [5, 6]. Because of dimension and weight of a belt it needs to be transported in rolls, pieces up to 100-400 m long, depends on a belt type. In order to replace damaged a gearbox or pulley heavy machinery is required. In some cases due to environment impact (for example rain) it takes a few times longer time.

III. ANALYSIS

According to the review, belt conveyor is essential equipment for transporting material from one point to other unloading point. Problems experienced with conveyor belt slippage around the drive pulley and severe wear problem on pulleys. In the belt conveyor, as the conveyor belt is traction components, transmit power and motion, and also is carrying components, support material load. Working more complex, so at work often happen belt and pulley slippage. As the conveyor belt slippage and wear may cause between the belt surface and pulley or drum, cause belt premature damage, ranging impact the life of conveyor, affect the throughput of material, weight is caused by withdrawal material, even happen stop occurrence, direct impact on production. As the conveyor belt is more important, the most expensive parts. Its price about 25%-50% to the conveyor. So analysis the reason of belt failure, to reduce and eliminate belt slippage over pulley during operation. It is an important part of ensure belt to work, extent equipment life. The parameters which impacts on designing of conveyor system are drum & belt design, drive mechanism, fire and safety controls, operation & maintenance, dust emission control, inspection and energy & efficiency controls. But all above parameters varied according to the requirement; however some parameters are equally impacts on each application, like drum & belt failure, energy & efficiency, drive mechanism, maintenance control and safety controls.

IV. POSSIBLE PROBLEM SOLUTIONS

1) For prevention and elimination of failures, as shown in above examples, to ensure the normal operation of belt conveyor, as the failure occurs in the existing belt conveyor and pulley or drum. An attempt is made in this study to minimize and mostly eliminate the slippage problem and wearing on belt conveyor and drum or pulley by modifying the internal belt surface and outer belt surface of

![Fig. 2: Examples of Pulley Faults](image1)

![Fig. 3: Distribution of Load along Belt - Idler Contact Area](image2)

![Fig. 4: Conveyor Belt](image3)
pulley will redesigned to increase the gripping power between belt and pulley.

2) Bearing used to ball bearing support, plastic sealing ring labyrinth seal structure, this can ensure roller worked reasonable force, while ensuring dust effect good, resistance small, easy assembly and disassembly, easy to maintain, reduce conveyor operating costs.

3) For gearboxes (geared wheel and bearing) and pulleys (bearings) may use a vibration measure based techniques and temperature measurement for bearing.

4) For idler condition thermograph measurement or noise may be used.

V. CONCLUSION

As requirement of continuous transportation equipment, belt conveyor is widely used in today's modern port. Wide ranges applications of belt conveyors, and the work environment is generally more difficult, to keep equipment running in good working condition, extend equipment life, improve the quality of operation, reduce operating costs has been the goal of engineering and technical personnel. Analyze and resolve the impact normal operation of the main problems, to ensure the good functioning of device, it is an important work of equipment maintenance. To fulfill above requirement it is to be needed further proper designing of conveyor system which is desired for the application keeping all parameters in mind and by inventing new approaches towards better design. It has been also focused on inspection and online monitoring of all components while transferring coal through belt conveyor to reduce maintenance cost & fatal accidents in mines.

VI. REFERENCES


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