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Establishing failure patterns of a Belt Conveyor system configuration

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Abstract: Conveyor belts are one of the most crucial pieces of mining equipment, and they're mostly utilized to transfer crushed minerals from the crushing station to where they'll be further processed. The increasing complexity of belt conveyor systems has made maintaining their integrity even more difficult, as they are now utilized in a variety of sectors, environments, and carry goods of varying weights, making them vulnerable to failure.This paper presents industry-specific knowledge about belt conveyor systems, their components, and how they are configured utilizing fault tree analysis to anticipate the various events that can lead to a belt conveyor system's failure. The application of fault tree analysis gives further light on how cascading failures, in which the failure of one component leads to the breakdown of the entire system, might occur.

Keywords:RCFA,FMEAOpex,FTA,Capex,Eca,Ttf,Ttr.

INTRODUCTION

In recent years, the mining industry has been hit by a slew of disasters around the world as a result of shoddy planning and a lack of functional reliability improvement programmes. Regulatory bodies never take equipment failures lightly because they might reveal how well or poorly a corporation has prioritized asset safety and integrity management. That being said, there are several cost and time effective ways of properly anticipating failures in systems, components, and their sub-components to better manage assets and minimize disasters caused by equipment related failures. One of these techniques is fault tree analysis (FTA), which uses failure data from an equipment to predict different branches of failure and cascading faults. FTA was chosen for this work because of its relevance and enhanced accuracy in the domains of asset risk management and reliability. The prevalent failure patterns of conveyor belts are examined in this research, and implications are derived from the findings.

THE CONVEYOR BELT SYSTEM

Belt conveyors have been utilized in a variety of industries for over two centuries, including petrochemicals, mining, manufacturing, and production. The belt conveyor system is primarily used to transport bulk materials from one station to another; it has proven to be

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very effective and time-saving, as well as very easy to maintain, making it a cost-effective solution for a variety of industrial applications.The mining sector is the topic of this article, and the following parts will go over the various components within the system as well as the frequent failure mechanisms that contribute to system failure. A fault tree analysis will be built to illustrate all branches of component failure or events that could lead to the complete system's total failure and unavailability.

Fig.1The belt conveyor system

A. Individual failures of various components within the belt conveyor system occur over time owing to variables like as wear and tear, corrosion, overloading, and pressures. Identification the reason of failure can be difficult unless you conduct rigorous study and fault-findingutilizing reliability-centered maintenance tools like root cause failure analysis (RCFA), failure mode and effect analysis (FMEA), fault tree analysis, and other well-known reliability improvement tools.

B. Major Subsystems within the Belt Conveyor System

The typical belt conveyor system used in open pit and underground mines consist of the idler which have bearings, the drive unitwhich houses the gearbox, the pulleys, the scraper and the skirt board, as some the main subsystems. The complete diagram of the drive unit is shown in the figure below.

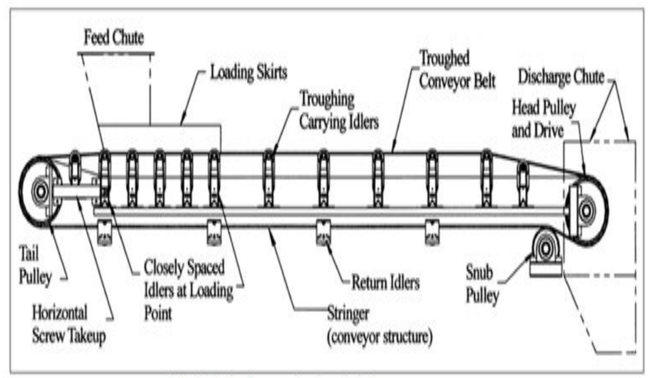

Fig.2A basic diagram showing the belt conveyor system

C. The Pulley

Pulleys are a key component of belt conveyors; they're typically made of steel and are regularly utilized to deflect and support the conveyor structure. Pulleys also assist in the training of the conveyor belt to run properly along the idlers.

The location of pulleys varies along the construction; some are located near the beginning of the structure, while others are near the end of take-up. Pulleys aid in the efficient transmission of drive power via belts. Belts, in general, require a substantial amount of push to get started and stay moving; the thrust is

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useful in resisting frictional and gravitational forces. The bearing assembly and pulley shaft are significant subcomponents of the pulley, and their failure can contribute to the component's entire failure, as shown in the diagram below.

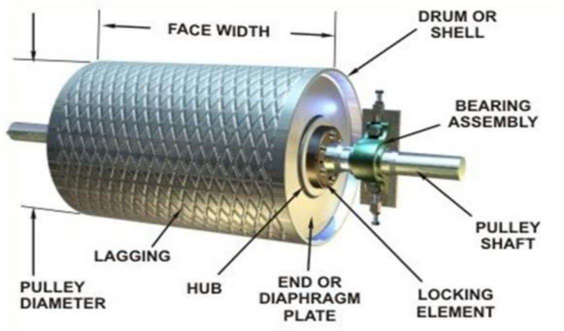

Fig.3 Showing the various subcomponents of the pulley

D. The Conveyor Belts

The belt is known as the system's primary component; it is one of the major components that allows materials to be transported to multiple stations; without the belts, there would be no base or ridged body to lay goods on. As a result, maintaining the belts has always been a top concern for maintenance employees. Depending on the nature of the materials conveyed, most belts require additional preventive maintenance checks.

If the goods being transported are liquid in nature, maintenance personnel must be cautious about leakage. Bulk minerals conveyed in mining are often heavy solids, making the belts prone to wear owing to their weight. Belts come in a variety of styles, with coated, covered, and strengthened belts being among the most popular.

E. The Idler

The Idler is made up of steel tube rolls that are mounted in the pulley head and are connected by shafts, bearings, and seals. Impact idlers, return idlers, and toughing idlers are the most often used idlers, coupled with toughing trainers. Idlers provide support to belts during material transportation, and because they are similar to pulleys, they fail in similar ways. Just like pulleys, worn out bearings in idlers will result in an increase in the external load that the drive unit carries, which can contribute to an increase in power consumption.

F. It's helpful to know that most idlers are already oiled at the manufacturer and ready to use. The care given to idlers while in service determines how long they stay in service. Maintenance workers must pay special attention to scheduled and periodic routine inspections on idlers, taking into account their operating and environmental circumstances.

G. The Drive Unit

The drive unit is one of the most important parts of the belt conveyor system; it consists of a 2-3 step gearbox and an electric motor that connects the outer shaft to the pulley. The gearbox, on the other hand, is the system's most dangerous component. There's a good chance that roughly 25% of gearboxes will need to be replaced every year due to catastrophic failures. The drive unit and its numerous subcomponents are depicted

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in the diagram below.

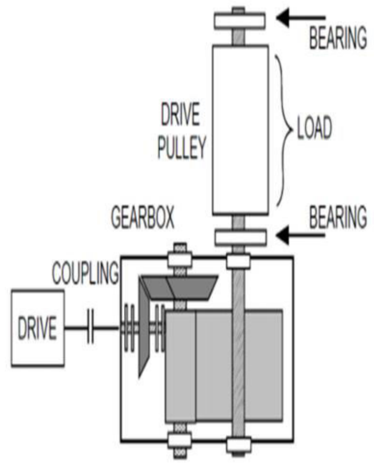

Fig.4 Representing the drive unit.

The pieces separately contribute to the driving unit's continuous operation, as depicted in figure 4. The bearing is normally in charge of the system's rotational efficiency. When it comes to providing rotating support to a belt conveyor system, the drive unit is often considered the primary supplier.

H. Scraper

The scrapper at the discharge pulley has two basic functions: to clean the conveying portion of the belt and to keep the return idlers from wearing out. Scrappers are often placed to clean the belt's innermost surface and act as a barrier to prevent items from falling into the gap between the tail pulley and the belt.

RESULT

A. Analysis of a Belt Conveyor system using FTA

Belt conveyor systems are known to be extremely dependable, but how long they will endure is largely determined by the maintenance approach implemented. Some components within the system are prone to normal wear during the useful life of the equipment, regardless of how well they are maintained, hence duty holders must pay close attention to the most failure prone components. In most situations, maintenance teams would plan a yearly plant closure during which all equipment would be overhauled. The fault tree diagram can be used to depict cut sets and combinations of subsystem failures that could lead to the main event. The many branches of events that can contribute to the collapse of the entire belt conveyor system are depicted in Fig. 5. In this analysis, the fixed unit is given moreweight.

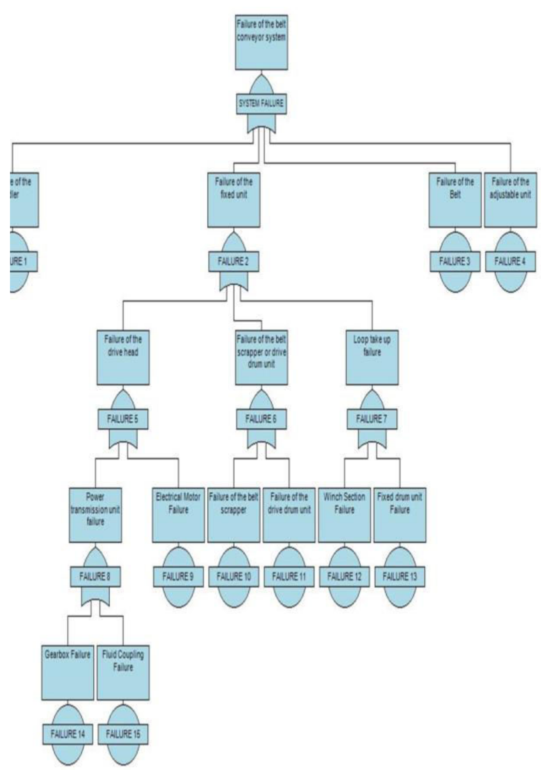

Fig.5 Representing the fault tree of the conveyor belt system.

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B. Figure 5 was created with the isograph software tool and depicts approximately fourteen (14) different individual single point of failures that can potentially lead to the failure of the entire system, which is the worst nightmare of several companies because it would have a direct impact on operations, operating, and capital expenditures (Opex and Capex). Some frequent failure modes will be addressed in the following sections to help you better understand how belt conveyors work.

C. BeltFailure

One of the most typical belt failures is the loss of the belt's inner structure, side and top covers; when this happens, the belt loses its tension retention ability owing to the belt being ripped. The top coverings also wear down over time, making it more difficult for them to protect the inner structure. Finally, the side coverings wear out with time, exposing the inner service.

D. Failure of the Drive System

The motors find it difficult to freely rotate, the bearings get easily worn out, causing low friction. The gear-box loses some of its tooth, making it extremely to transfer power. In general, the failure of the drive system happens in such a way that, they are unable to supply sufficient power to the belts, this reduced efficiency directly affects the entire component and would usually require urgentcorrectiveactions.

E. Idler Failures

Idlers are known for their capacity to help align the belt, but when they lose that ability, the belts run with uncontrolled friction. Typically, they are unable to maintain high rolling resistance indefinitely.

F. The Brake System

The braking system is used to intervene in an emergency by reducing the pace of the belts; however, if the brake system fails, it becomes nearly impossible to slow the belts down. Duty holders must ensure that the system is lubricated at all times by performing proper preventative maintenance checks.

CONCLUSION

In open pit and underground mining, the belt conveyor system is still an important piece of equipment. FTA was used in this research to analyze real-world belt conveyor setups and scenarios collected from many mining organizations, as well as individual subject matter expertise, and the results were used to derive relevant conclusions. Regardless of mining companies' maintenance strategies, dealing with unforeseen breakdowns has remained an issue, making present efforts insufficient. Early failure identification is the most important determinant element for improvement, thus identifying bad actors and arranging a comprehensive evaluation of current preventive, predictive, and corrective maintenance plans should be prioritized. Predictive maintenance technology is unquestionably the way to go, since it can detect failure causes such as temperature, pressure, and vibration changes in fixed and rotating assets

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before they fail.

It is critical that more attention be paid to improving maintenance tasks for essential components within the belt conveyor system, such as rollers, picking belts, idlers, and pulleys, which are prone to failure. Due to their series arrangement, which makes each individual component of similar importance, the total system reliability of the conveyor belt can be jeopardized if only one component fails.

Finally, every minute lost during downtime costs thousands of dollars, which has an impact on revenue production and the company's overall reputation.

REFERENCES

[1] Ortmeier F, SchellhornG.FormalFault TreeAnalysis-PracticalExperiences. Vol.185,ElectronicNotesinTheoretical ComputerScience.2007.p.139–51.

[2] ZeeuwVanDerLaanB.Systemreliabilityanalysisofbeltconveyor.2016;(March):73.Availablefrom:http://mararchief.tudelft.nl/file/45179/

[3] ABB.Miningconveyorsystems _ABBconveyorsolutions-Beltconveyorsystems (Crushing andconveying)[Internet].ABB;2021. Availablefrom:https://new.abb.com/ mining/crushing-conveying

[13] 1

[4] VelmuruganG,PalaniswamyE,SambathkumarM.ConveyorBeltTroubles(BulkMaterialHandling).2014;2(3):21–30.

[5] ZimrozR,KrolR.Failureanalysisofbeltconveyorsystems forconditionmonitoringpurposes.Studi Mater.2009;(36):255–70.

[6] Pulleys_Basicsofconveyorpulleys[Internet].CKIT;2020.Available from:https://www.ckit.co.za/

[7] TheseR, CarefullyI, StartingB. ReadTheseInstructionsCarefullyBeforeStartingInstallationBeltConveyorIdler. :1–8.

[8] Gupta S, Bhattacharya J, Barabady J, Kumar U. Cost-effective importance measure: A new approach for resource prioritization in a production plant. Int J QualReliabManag.2013;30(4):379–86.

[9] Dwi-weibullBST.SOMEPROPERTIESOF BI-WEIBULLDISTRIBUTIONS.2008;4(April):2003–4.

[10] SimpsonFM.TheUseofWeibull AnalysisMethodsinAssessingFieldFailureProblems.1994.

[11] TechnologyC.WeibullReliabilityAnalysis=⇒.1999;Availablefrom:http://www.rt.cs.boeing.com/MEA/stat/reliability.html

[12] Engineeringstatisticshandbook.8[Internet].NIST&Sematech;Availablefrom: https://www.itl.nist.gov/div898/handbook/apr/section1/apr162.htm