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Identification of Critical Components of Underground Mine Conveyors for Maintenance Optimization: Case of the Gara Underground Mine

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***Abstract:** The development of a maintenance plan for conveyors of the Gara underground mine represents a major challenge for improving the efficiency of ore transport operations. This work aims to develop a methodical and structured approach for the implementation of a maintenance plan, adapted to the specificities of conveyors used in an underground environment.*

With a view to developing a preventive and corrective maintenance plan for the mine conveyors, reducing downtime and optimizing the performance and life of the facilities. Specifically, we will identify critical components, define the necessary maintenance tasks. The development of this plan aims to optimize the performance of the conveyors while controlling the costs related to failures.

The methodology includes the analysis of technical specifications, the identification of critical components using PARETO diagrams.

This project shows how crucial it is to adopt an organized approach for the maintenance of conveyors in a mining context. A well-developed maintenance plan can significantly improve the performance and durability of equipment. The most critical components were the rollers.

Keywords: Critical Components, PARETO Diagram, Conveyors, Maintenance

I. INTRODUCTION

Belt conveyors are increasingly used for handling ores, due to its effectiveness and efficiency compared to other forms of transport [1]. However, to obtain high performance from these conveyors, they must be maintained in optimal operating condition [2]. It is essential to develop a maintenance plan to ensure the proper operation and longevity of belt conveyor systems [3]. The objective of this article is to determine in detail the different stages and critical components in order to implement an effective maintenance plan adapted to the particularities of mining [4]. By identifying the essential elements, organizing frequent interventions and training personnel, it is possible to prevent malfunctions, reduce repair expenses and improve operational safety [5]. In this work, the essential principles of preventive, conditional and systematic maintenance have been examined [6]. And we propose strategies to improve the performance of belt conveyors, thus ensuring continuous and safe production [7].

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II. MATERIAL AND METHOD

The methodology included the collection of data on the various breakdowns that occurred during the period from January 1, 2022 to August 31, 2024, or thirty-two (32) months in total [8]. Excel software was used to analyze the collected data, using PARETO diagrams. The breakdowns that occurred over the thirty-two (32) months are summarized in the following table I.

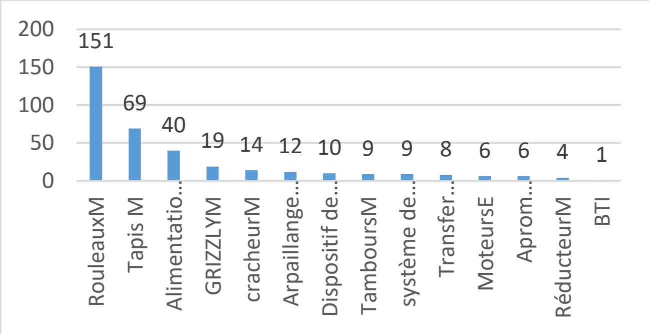
Table 1: Breakdowns Occurring on the Conveyor from January 1, 2022 To August 31, 2024

Composants	Number of Failures	Cumulative Number of Failures	%Cumulative
Rollers	151	151	42,30%
Belts	69	220	61,45%
Power supply	40	260	72,63%
GRIZZLY	19	279	77,93%
Spitters	14	293	81,84%
Electric Arpaillange	12	305	85,20%
Tension device	10	315	87,99%
Drums	9	324	90,50%
Safety system	9	333	93,02%
Transfer chute	8	341	95,25%
Motors	6	347	96,93%
Aprom feeder	6	353	98,60%
Reducers	4	357	99,72%
BTI	1	358	100,00%

This step was crucial for the determination of the element in the conveyor maintenance system.

III. RESULT

The analysis of the data in Table 1 allowed to draw the following Figure 1 for the determination of the critical component.



[Fig.1: Statistical Analysis of the Collected Data]

The Figure 1 shows that the rollers are the most critical elements. After the rollers come the conveyor belts (belts), drums and other elements of the system.

After the classification of the critical elements, the Pareto diagram was used to analyze the causes of the failures. The use of the PAERETO law required a fragmentation of the ore transport system into subassemblies for a better analysis.

A. Distribution of the Machine into Subassemblies

The subassemblies of the machine are:

- Control circuit: motor; reducer; drum; bearing….
- Transport group: belt; Drums; rollers; transfer chute…
- Tension system: tensioner; counterweight….
- Loading circuit: GRIZZLY; BTI; Aproom feeder…
- Electrical system: power supply; apparatus…
- Auxiliary function circuit: performs all tasks associated with lifting crushed stones; stone crushing machine that obstructs the operation of the crusher….

The Table II summarizes the conveyor failures according to the defined subassemblies.

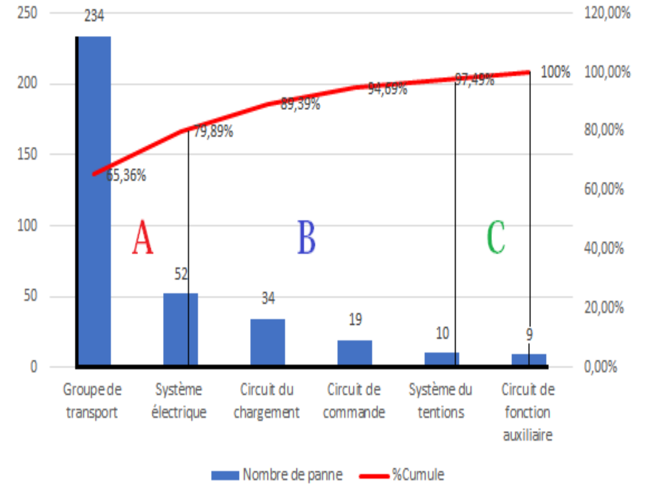
Table 2: Breakdown of Failures by Subassembly (01/01/2022 To 31/08/2024)

	Subset	Number of Failures	%	% Cumulative	% of Groups
A	Transport group	234	65,36%	65,36%	33%
	Electrical system	52	14,53%	79,89%	
B	Loading circuit	34	9,50%	89,39%	50%
	Control circuit	19	5,31%	94,69%	
	Tension system	10	2,79%	97,49%	
C	Auxiliary function circuit	9	2,51%	100%	17%
	TOTAL	358	100%		100%

The subsets are divided into three subgroups: A, B, C.

B. PARETO Diagram

The diagram is produced from table II illustrated in figure 3.



[Fig.3: Pareto Diagram]

The interpretation of figure 3 shows that the PARETO diagram is divided into three zones:

- Zone A: it causes 79.89% of breakdowns; this zone includes the transport and electrical system groups, it requires special attention.
- Zone B: It is the cause of 17.60% of stops; it concerns the Loading, Control and Tension System Circuit.
- Zone C: it is responsible for the remaining 2.51% of breakdowns.

IV. CONCLUSION

The ore conveying system is one of the essential pillars in the mining industry, and it is imperative to ensure the proper functioning and optimization of belt conveyors. Determining the critical components of the conveyor system allowed the development of a suitable maintenance plan to reduce interruptions and improve the performance and service life of the facilities. And the Pareto chart made it possible to effectively structure the maintenance plan and ensure complete coverage of maintenance needs.

DECLARATION STATEMENT

After aggregating input from all authors, I must verify the accuracy of the following information as the article's author.

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- **Funding Support:** This article has not been sponsored or funded by any organization or agency. The independence of this research is a crucial factor in affirming its impartiality, as it has been conducted without any external sway.
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- **Data Access Statement and Material Availability:** The adequate resources of this article are publicly accessible.

- **Authors Contributions:** The authorship of this article is contributed equally to all participating individuals.

REFERENCES

1. (s.d.). DJOUEMA Naima, Surveillance et Diagnostque Des Convoleurs à Bande, Thes de Doctorat, Univertcité badji mokhtar, Annaba. Récupéré sur https://biblio.univ-annaba.dz/wp-content/uploads/2019/11/These-Djouema-Naima.pdf
2. (s.d.). Louni, L. (2019). Étude d'un engin marin nettoyeur (Doctoral dissertation, UNIVERSITE MOULOUD MAMMERI TIZI-OUZOU). https://dspace.ummto.dz/items/8d2f0a59-8015-496b-a79f-27125fc4adf0
3. (s.d.). N, D. (2018/2019). <<surveillance et diagnostque des convoleurs à bande>> Thes de Doctorat, Univertcité badji mokhtar, Annaba.
4. (s.d.). Sécurité des convoyeur a courroie http:j/www.csst.qc.ca/ a 19/05/2024.
5. (s.d.). Jouhaina, BOUCENNA (2019). AMELIORATION DES PERFORMANCES ENERGETIQUE DES CONVOYEURS A BANDE (Thèse de doctorat, UNIVERSITÉ BADJI MOKHTAR-ANNABA). https://biblio.univ-annaba.dz/ingeniorat/wp-content/uploads/2019/10/Boucenna-Jouhaina.pdf
6. Rao, Dr. G. V. R. S., & Arshad Ali, M. (2019). Design and Analysis of Flip Type Scrapper for Belt Conveyor System. In International Journal of Innovative Technology and Exploring Engineering (Vol. 8, Issue 12, pp. 3291–3294). Doi: https://doi.org/10.35940/ijitee.l2806.1081219
7. Kamble, Mr. U., Paturkar, M. S., Swami, Ms. P., Malwade, Mr. S., Dholkawala, Prof. M. S., & Bhise, Mr. A. (2020). Design and Analysis of Inclined Belt Conveyor System for Coal Loading for Weight Reduction. In International Journal of Recent Technology and Engineering (IJRTE) (Vol. 9, Issue 2, pp. 707–711). Doi: https://doi.org/10.35940/ijrte.a2412.079220
8. Poornachand P, Vijayaramaraju Poosapati, Abinash Tripathy, Vedavathi Katneni, Building Intelligent Conveyor System using classification techniques in a logistics Industry. (2019). In International Journal of Engineering and Advanced Technology (Vol. 8, Issue 6, pp. 2116–2121). Doi : https://doi.org/10.35940/ijeat.f8484.088619