International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 08 Issue: 07 | July 2021 www.irjet.net p-ISSN: 2395-0072

Application of Failure Mode and Effect Analysis for dumper in Opencast Mines

G. Rajasekhar Reddy[1], G. Shiva[1], L. Bhanuprathap Reddy[1], Saidulu[1], A.C. Kumar[2]

[1]B. Tech, Department of Mining Engineering, Godavari Institute of Engineering and Technology
[2]Associate Professor, Department of Mining Engineering, Godavari Institute of Engineering and Technology

---

Abstract: *Excavation of minerals are required for the development of any nation. With the increase in demand for the excavation of mineral, mechanization in the mines, especially in the opencast mines has increased exponentially. The main recurring accidents in opencast mines are associated with dumpers. Dumpers are used to carry ore and waste in open pit mines. Failures of dumper have an impact on mine production and can lead to accident. In this paper the risks associated with dumpers operations using Failure Mode and Effect Analysis (FMEA) were examined. The aim of FMEA is to determine the failure effects of different failure modes.*

Keywords: Opencast mining, Risk Assessment, FMEA, Dumpers

Introduction

Open pit mining, as one of the two ways of production in the mining industry, appears to have a more stable working environment, but it also has its own set of risks. Slopes, water income, equipment, falls, hand tools, and dust are all dangers that must be considered in this manufacturing technique. Due to variations in working circumstances across diverse occupational groups in open-pit mining, there is a wide variety of chances for experiencing dangerous situations.

Risk Assessment is a process of identifying the hazards and providing the control measures to minimize the risk. It is a detailed examination of your workplace to discover those items, circumstances, procedures, and other factors that might damage people or property. After the identification was made, there is a need to examine and assess how likely and serious the danger is. After reaching the conclusion, a decision has to be made on what steps should be taken to remove or control the harm successfully.

For doing risk assessment there are mainly three types. 1) Qualitative Method 2) Quantitative Method 3) Semi Quantitative Method. Qualitative risk assessment approaches are quick and simple to apply since broad implications and likelihoods may be recognised, and they can offer a general knowledge of comparative risk between risk events using the risk matrix (ratings). Quantitative risk techniques, on the other hand, are frequently not intuitive and need some upfront understanding by decision-makers. To address some of the limitations associated with qualitative techniques, semi-quantitative approaches to risk assessment are now frequently employed. Qualitative risk assessments produce a more detailed prioritised ranking of risks, whereas semi-quantitative risk assessments produce a more detailed prioritised ranking of hazards. Semi-quantitative risk assessment goes one step farther than qualitative risk assessment by assigning values or multipliers to the likelihood and outcome groups. Multiplication of frequency levels with a numerical rating of consequence may be used in semi-quantitative risk assessment approaches. There are several scale combinations that can be used.

Exact hazard identification and risk assessment are the most important factors for mitigating the risks in the mining sector. The hazard probabilities of opencast mines were determined. In this study FMEA was used to assess the risks associated with dumpers

Methodology

FMEA stands for Failure Mode and Effects Analysis. Improvement teams use the systematic method of an FMEA to identify potential ways for a product or process to fail, describe the consequences, quantify the severity of

those potential failures, and estimate the chance of them occurring. FMEA focuses on system and individual component failures, as well as how those failures affect facilities and processes (Sharma et al., 2005). The FMEA process is shown in Figure 1.

Key steps involved in FMEA

1. All system components are listed
2. Identify the failure modes
3. Each component failure mode's repercussions are described in detail
4. Identification of preventive measures to protect against the causes

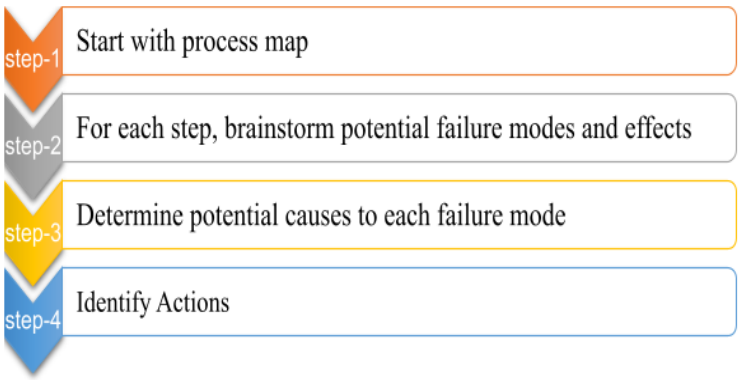

Figure. 1: FMEA process

Application of FMEA to dumpers in a mines

Identifying the dangers that come with the presence of automobiles at work (e.g., reversing operations, loading) is important and it will be dangerous if not managed correctly. Some of the elements that may increase the likelihood of a dumper collision include (Tripathy and Ala, 2018; Bohm and Harris, 2010):

- Access roads that are difficult to navigate
- Time pressure
- Inadequate brakes
- Vehicles that have been parked carelessly
- Untrained drivers
- Overturning vehicles

FMEA is applied to dumpers in a Mine-A. The hazards of dumpers identified in opencast mining are presented in Table 1 and the control measures are presented in Table 2.

Table 1: Application of FMEA to Dumpers

Component	Failure Mode	Failure Effect
Tyres	The sudden loss of air pressure in the tyre.	There may be a cause of mineral fall and may lead to accidents
Break	• Poorly adjusted brakes. • Overheated brakes. • Worn brake components	• Poorly adjusted breaks lead to accidents • Overheated brakes lead to accidents • Worn brake components lead to

		accidents
Operator	Driver negligence	It may cause sudden accidents
Ground conditions	Low strength of soil. High inclination of the road ways.	Over turning, side falling of dumpers.

Table 2: Control Measures for dumpers

Component	Failure Mode	Failure Effect	Control measures
Tyres	The sudden loss of air pressure in the tyre.	There may be a cause of mineral fall and may lead to accidents	- Regular maintenance - Road cleaning
Break	● Poorly adjusted brakes. ● Overheated brakes. ● Worn brake components	● Poorly adjusted breaks lead to accidents ● Overheated brakes lead to accidents ● Worn brake components lead to accidents	- Regular maintenance - Checking brake oil - Use lubricants
Operator	Driver negligence	It may cause sudden accidents	- use experienced people - Give rest to the dumper operators
Ground conditions	Low strength of soil. High inclination of the road ways.	Over turning, side falling of dumpers.	- Check ground conscious - Watering the earth surface - Do not transport heavy material at a time

Conclusion

One of the most recurring accident in opencast mines is associated with the dumpers. In this study, FMEA analysis of dumpers was performed to identify the possible failure modes and subsequent failure effects of the identified failure modes. The identified failure effects will help the mine management in framing the Safe Operating Procedures for dumpers.

References

1) Bohm, J., & Harris, D. (2010). Risk perception and risk-taking behavior of construction site dumper drivers. International journal of occupational safety and ergonomics, 16(1), 55-67.

2) Tripathy, D. P., & Ala, C. K. (2018). Identification of safety hazards in Indian underground coal mines. Journal of Sustainable Mining, 17(4), 175-183.

3) Sharma, R. K., Kumar, D., & Kumar, P. (2005). Systematic failure mode effect analysis (FMEA) using fuzzy linguistic modelling. International Journal of Quality & Reliability Management.