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Abstract of the Thesis



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Title of Thesis: Development of Reliability, Maintenance and Safety

Model for Belt Conveyor Systems Using Structural Methodology

Abstract

Belt conveyor systems are the preferred method of conveying bulk goods across industries due to their reliability, flexibility, and ability to handle massive material inventories. Downtime costs production time and money, thus belt conveyor systems must be reliable. Maintaining a conveyor belt system keeps it safe and reliable. Thus, belt conveyor reliability, maintenance, and safety are crucial. Heavy equipment maintenance, including belt conveyor installations, is increasingly outsourced. However, owners and operators of such systems struggle to find a reliable contractor for maintenance. This study presents frameworks for belt conveyor system dependability assessment, contractor selection for maintenance outsourcing, and safety performance measurement.

System reliability depends on several factors. The plant's design and operating circumstances' dependability qualities will be used to create a reliability index in this study. Literature analysis and plant professional interviews found five belt conveyor dependability characteristics. Using a structural methodology based on graph theory and matrix approach (GTMA), the belt conveyor system reliability index (BCSRI) and ratio were calculated. Sugar plant conveyor belt reliability was assessed using the framework. Sensitivity research showed that conveyor belt system design primarily affects the reliability index. The approach allows methodical diagnostic and reliability improvement. The hydraulic direct drive system is crucial to belt conveyor performance and reliability. Complete system failure and significant output losses can result from this component failure. To solve this issue, FMEA was used to identify potential failure modes and assess their influence on system performance. The study identified important components and suggested preventive maintenance to improve system dependability and reduce downtime. Maintenance for belt conveyor installations is commonly outsourced. Outsourcing maintenance has many issues. This study examined belt conveyor maintenance outsourcing problems. To choose the best maintenance contractor, Analytic Hierarchy Process (AHP) and PROMETHEE-II were combined. Financial health, organizational strength, service track record, maintenance service quality, personnel skills, tools and equipment support, and health, safety, and environmental practices

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Ph.D.Programme

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were the seven core evaluation criteria. The recommended contractor selection technique is systematic and open.

Belt conveyors must be safe, reliable, and maintained. Thus, belt conveyor safety performance must be measured to ensure plant safety. Safety performance variables, such as belt conveyor system design and operation, are highlighted. A digraph models factors and their relationships. A belt conveyor system safety performance function (SPF) was obtained from the digraph's equivalent matrix, allowing the development of an SPI. The safety performance measuring methodology was used to assess fertilizer plant belt conveyor safety. It lets designers compare conveyor system designs for safety. The safety performance index (SPI) can help plant operators identify poor contextual elements and create mitigation actions.

This PhD thesis will provide a systematic and integrated approach to improve belt conveyor system reliability, maintenance, and safety across industrial applications and help owners and operators choose suitable maintenance contractors.

List of Publications

1. N.J.Parmar, Ajith Tom James (2021). Development of a framework for safety performance measurement of belt conveyor systems, International Journal of Productivity and Performance Management, Vol. 72 No. 4, pp. 1001-1024.
2. N.J.Parmar, Ajith Tom James, Mohammad Asjad (2023). Analysis of maintenance outsourcing challenges for belt conveyors in the Industry 4.0 era, Journal of Global Operations and Strategic Sourcing, Vol. 16 No. 3, pp. 718-744.
3. N.J.Parmar, Ajith Tom James, Mohammad Asjad, Zahid A Khan (2025). Development of a framework for contractor selection for outsourced maintenance services of belt conveyor installations, International Journal of Quality and Reliability Management, Vol.43 No.26, pp.761-783.